The Weather Guide

A Weather Information Companion for the Forecast Area of the National Weather Service in San Diego

1st Edition

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Quick Reference

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For additional contact information, including directions to the office and tour information, click on "Office Information" on our home page.

Latest National Weather News - Click on: **www.nws.noaa.gov/pa**

Requests for Climate Data

Official detailed historical weather conditions are not archived at the NWS in San Diego, except for San Diego - Lindbergh Field data. Climate data are available in hourly, daily, monthly or seasonal breakdowns for locations in the western U.S. through the Western Regional Climate Center in Reno, Nevada. Climate normals, monthly and seasonal data for Southern California are available on their web site: **www.wrcc.dri.edu/summary/climsmsca.html**
Hourly and daily data require a special request by contacting them directly:
email: wrcc@dri.edu
phone: 775-674-7010
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Introduction

This weather guide is designed primarily for those who routinely use National Weather Service (NWS) forecasts and products. Its purposes are to:

! provide answers to common questions
! describe the organization, the people, and functions of the NWS - San Diego
! explain what NWS products mean and the unique terminology used
! describe specific challenges local NWS forecasters face in producing accurate forecasts
! create a better general understanding of the particular weather and climate of our region
! provide a weather event history of the region
! provide numerous resources for additional information

The desired effect of this guide is to help the general public and journalism community gain a greater understanding of our local weather and the functions of the National Weather Service. We hope to improve relationships among members of the local media, emergency management, and other agencies with responsibility to the public. With a spirit of greater cooperation, we can together provide better understanding and services to our residents and visitors.

The National Weather Service in San Diego invites anyone with any interest to our office for a free and informal tour. We especially encourage members of the weather community or meteorology students to take advantage of this nearby resource and become familiar with the science, our work, and the local weather. We have various training and educational resources for those pursuing a career in meteorology or for those seeking a greater understanding of the science and its local applications.

Contents

The National Weather Service

Mission

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the **protection of life and property and the enhancement of the national economy**. NWS data and products form a national information database and infrastructure which can be used by other governmental agencies, the private sector, the public, and the global community.

This mission is accomplished by providing warnings and forecasts of hazardous weather, including thunderstorms, flooding, hurricanes, tornadoes, winter weather, tsunamis, and climate events. The NWS is the sole United States **official** voice for issuing warnings during life-threatening weather situations.

Brief History

The National Weather Service was created as a branch of the Signal Service, later the Signal Corps of the Army, by a Joint Congressional Resolution in 1870. It provided "for taking meteorological observations at the military stations in the...United States, and for giving notice...of the approach and force of storms."

The benefits of the weather service were soon recognized by business industries, the general public, and farmers who demanded special forecasts and warnings applicable to their needs. This led to the creation of a new organization with a more scientific status. Congress transferred the weather service of the Army to the Department of Agriculture in 1891 and named it the U.S. Weather Bureau.

Before World War II, technology and communications improved slowly, but the war accelerated the need for aviation forecasts, and an increase in technology and participation by all sectors of society, including women. More employees, training and resources were poured into the war effort. Advances in satellite and radar technology soon followed. During the 1950s and 1960s organizational changes took place, including the distribution of local forecast offices across the country. In addition, numerous national centers were established to provide support for numerical weather prediction, research, climate archives, climate prediction, hydrology, aviation weather, marine weather, severe storms and hurricanes. In 1970 the Weather Bureau changed its name to the National Weather Service (NWS) and became part of the newly formed National Oceanic and Atmospheric Administration (NOAA).

Since then many more advances have taken place in computer technology, allowing for greater power in producing numerical model guidance used by meteorologists. Satellites have become more sophisticated in the weather features they can detect. In the 1990s a “Modernization and Restructuring” effort was realized. Doppler Weather Radars were installed nationwide, representing a vast improvement over the old radars. New Advanced Weather Interactive Processing Systems (AWIPS) were installed nationwide in 1999. These workstations provide meteorological data, model guidance, satellite imagery and radar data with great flexibility in data manipulation and analysis. In 2000 a massive computer upgrade was made to allow greater speed and stability in generating numerical model guidance. As the capacity of technology and understanding increases, forecasts become more accurate and extend further into the future. The NWS is the world leader and provides the basic infrastructure for all operational weather forecasting. For more history and stories, click on: **www.history.noaa.gov/nwstales.html**

NWS Organization

The National Weather Service is part of NOAA, the National Oceanic and Atmospheric Administration, which is part of the Department of Commerce in the U.S. Government. As noted in the mission statement, the entire weather database and infrastructure in this country (i.e. satellites, radars, weather monitoring stations, model guidance, etc.), is provided and maintained by the NWS. Private weather companies, consultants, media outlets, and research organizations all depend on this infrastructure.

It is easy to see why the NWS is part of the Department of Commerce. Numerous professions are directly impacted by the weather and countless decisions are made in response to weather forecasts. For example, anybody who works outdoors such as construction crews must monitor the forecast and make cost-saving decisions. Industries of transportation, agriculture and recreation depend heavily on weather information. Indirectly, some industries like the stock market may be impacted as entire local economies can be affected by drought or damaging weather. In fact, it is hard to find a profession not in some way affected by the weather.

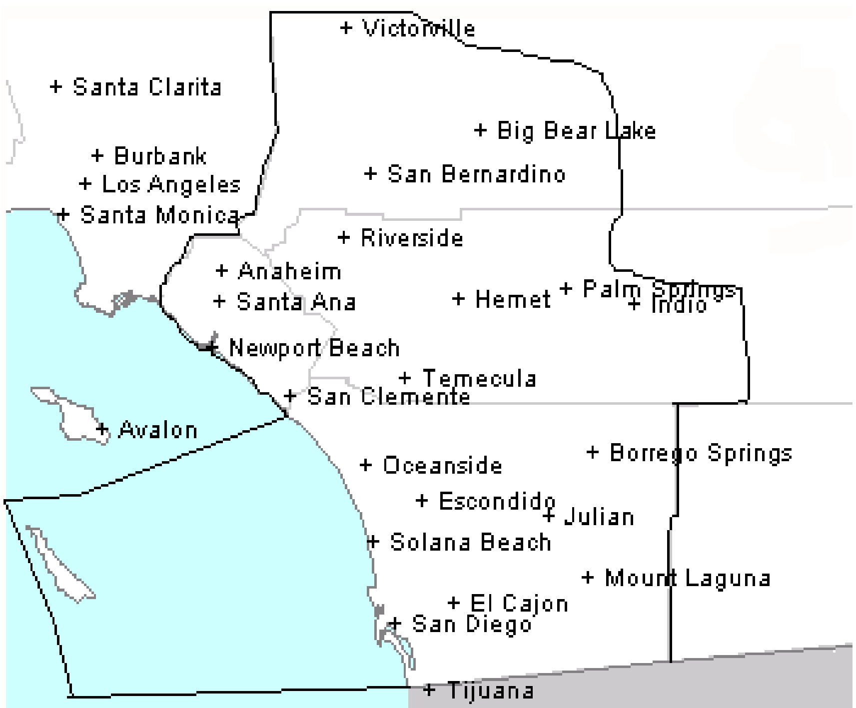
The NWS is comprised of many national centers which provide support and guidance to the nation's 121 forecast offices and 13 River Forecast Centers (RFCs). For web links to these centers, click on: **www.wrh.noaa.gov/wrhq/nwspage.html.** These centers include:

- Aviation Weather Center (AWC)
- Climate Diagnostics Center (CDC)
- Climate Prediction Center (CPC)
- Environmental Modeling Center (EMC)
- Hydrometeorological Prediction Center (HPC)
- Marine Prediction Center (MPC)
- National Center for Environmental Prediction (NCEP)
- National Climatic Data Center (NCDC)
- National Hurricane Center (NHC)
- National Severe Storms Laboratory (NSSL)
- Storm Prediction Center (SPC)

Several regional centers oversee forecast offices within their region of the country. The Western Region Headquarters directs the operations of forecast offices in the western states, including the San Diego office, from its office in Salt Lake City.

The NWS in San Diego

The San Diego Forecast Office prepares forecasts and any necessary warnings for a sizable area of Southern California, which is called a County Warning Forecast Area (CWFA or CWA). The San Diego CWA comprises all of Orange and San Diego Counties, western Riverside County, southwestern San Bernardino County and adjacent coastal waters off San Diego County. The CWA is divided into forecast zones, each containing roughly similar climates. A zone forecast is made for each zone. Often when a similar forecast is expected for more than one zone, these zones are grouped together. Forecast operations run continuously 24 hours a day, 365 days a year. The San Diego Forecast Office meteorologists are among the best experts of local weather and climate. They keep informed of research developments and the latest discoveries and news that impact the weather, such as El Niño and climate prediction, but do not conduct the research themselves and therefore are not experts in those research fields.



A History of the NWS in San Diego

Weather observations were first taken in San Diego from 1849 to 1871 at the San Diego Mission de Alcala and at Ft. Stockton, now part of Presidio Park, by the Medical Corps of the Army. When the Army's Signal Service assumed the task in 1871, the weather observing station was moved downtown to Horton Square at present day Broadway between 3rd and 4th Avenues. The station moved around this area several times from 1871 until 1940, but always remained within a stone's throw of present day Horton Plaza. In 1890 the first Weather Bureau Office was located on 5th Avenue between E and F streets. In 1930 the office and a second weather observing station were relocated to the Lindbergh Municipal Airport 1 ½ miles northwest of the city office, but observations were continued downtown. In 1940 observations became official at Lindbergh Field. This new site was considered close enough and sufficiently similar in climate to the downtown location that the climate record was continued uninterrupted rather than starting a new separate record for the new location. In 1969 the weather equipment was moved to its current location at the General Aviation Building at Lindbergh Field, now San Diego's International Airport.

In 1970 the Lindbergh Field office became a National Weather Service Office with limited forecasting responsibility. The NWS office in Los Angeles provided the general forecasts for all of Southern California. The San Diego office adapted these forecasts for local use and issued warnings for San

Diego County in addition to the regular duties of taking weather observations at Lindbergh Field. In October 1995, the office at Lindbergh Field moved to Rancho Bernardo in the northern reaches of the city and discontinued taking the weather observations, but still maintained the climate record at Lindbergh with the help of automated equipment installed in 1996. In 1997 the San Diego Office made a gradual transition to full forecast office capacity. Orange, western Riverside, and southwestern San Bernardino Counties were added to San Diego County to create the current area of responsibility. Since 1997 all forecasts and warnings for our area originate from the office in Rancho Bernardo. Marine forecast and warning responsibility for adjacent coastal waters were added in 1999. In late 2002, the Interactive Forecast Preparation System (IFPS) was implemented. This bold new forecasting system provides NWS forecasts in a graphical format and with a great amount of detail.

The People of the NWS in San Diego

The current staff at the NWS in San Diego consists of 24 employees. Four managers and one assistant direct the work activities and administrative duties of the office. An Information Technology Officer maintains computer systems. 11 forecasters (or meteorologists) prepare and disseminate forecasts and warnings, and attend to focal point duties and other projects. Four hydrometeorological technicians and one meteorologist intern collect and disseminate data, operate the NOAA Weather Radio, manage the climate observer program, and answer phone calls from the public and media. Three electronic technicians maintain and repair observational equipment, including the two Doppler Radars.

The Meteorologist-in-Charge (MIC) position is currently vacant (June 2003). The MIC ultimately oversees all operations and work in the office and implements changes in policy or practices when required. Questions about policy, funding, employment, technology, and the future are best directed to the MIC.

Ed Clark is the Warning Coordination Meteorologist (WCM). He maintains relationships with our partners in service, i.e., emergency management, agencies of flood control and law enforcement, fire departments, and the media. He keeps the staff current and proficient in correct warning practices, completes verification studies, and performs a variety of outreach activities.

Ivory Small is the Science and Operations Officer (SOO). He ensures that good forecasting techniques and good science are used by meteorologists through training and development. He implements the latest developments in technology and meteorological theory from the research community and produces some of the research himself. He is the best resource for questions about the meteorology behind the weather.

The first line of phone communication is usually with a hydrometeorological technician. They answer general questions about the weather, climate, or forecast, or can point you in the right direction for the answer. Forecasters on duty can provide greater detail about the reasons behind the current weather or forecast. Many questions of this nature can be answered by consulting the latest Area Forecast Discussion.

Occasionally, when not working basic operations directly, each member of the staff performs focal point duties. These include directing local programs, conducting special projects or overseeing other areas of responsibility. A list of the entire staff and the numerous duties they perform in addition to

operational duties can be found on our staff web page:
www.wrh.noaa.gov/sandiego/office/staff.htm.

Communications and Product Dissemination

Products and information disseminated from the NWS are transmitted in a coded format. Each product name is identified by its code containing eight or nine letters. The code formula is cccNNNxxx, where ccc is the regional node, NNN is the product identifier, and xxx is normally the originating forecast office. For example, LAXZFPSGX indicates Los Angeles (LAX) is the regional node, the Zone Forecast Product (ZFP) is the name of the product, and San Diego-Rancho Bernardo (SGX) is the originating office. When a product is sent from the office, it goes to Gateway, the communications center for the NWS. From there, the products are disseminated to the world. News services and private weather information companies then pick up these products and send them to users. The NWS maintains the largest meteorological telecommunications switching center in the world, sending and receiving over 400,000 meteorological bulletins each day.

The NWS relies heavily on its partners in emergency management and the media to keep communities safe and well informed. Emergency managers and the media have timely access to severe weather information through a number of systems and services. For information on how to set up a service to receive real-time weather information, contact our Warning Coordination Meteorologist, Ed Clark, at 858-675-8700 ext. 223.

The **Family of Services** includes the NOAA Weather Wire Service, NOAAPort and news agencies such as AP, UPI and City News Service. These systems provide paying subscribers consistent and timely weather information in real time.

Private commercial information vendors supply numerous paying customers with weather information packages tailored to their needs.

Emergency management and flood control agencies in California can receive timely information through the **California Law Enforcement Telecom System** (CLETS). This originates from the State Office of Emergency Services in Sacramento. The **Emergency Manager's Weather Information Network (EMWIN)** provides real time information for a one-time cost for equipment and installation. Email and pager notification can be easily set up. This information may not be as reliable or timely as that found with the Family of Services. The **Interactive Weather Information Network (IWIN)** is a free Internet site with live data similar to EMWIN and a large selection of products. You can find it at: **www.weather.gov**. However, it is subject to the availability and connection problems inherent to the Internet.

Please note: The Internet is **not** the primary means of disseminating weather information from the NWS and **should not be relied on,** especially during significant weather events.

Local Programs - Click on "local programs" on our homepage for more information

The **Aviation** program encompasses the preparation and verification of Terminal Aerodrome Forecasts (TAFs) and Transcribed Weather Broadcasts (TWEBs). TAFs are coded 24-hour forecasts updated at least every six hours. TAFs give detailed weather conditions expected at six area airports: San Diego-Lindbergh Field (SAN), McClellan-Palomar Airport (CRQ), Orange County-John Wayne (SNA), Ontario (ONT), Palm Springs (PSP), and Thermal (TRM). Soaring forecasts are generated daily. Aircraft accident reports are issued for fatal accidents.

The **Cooperative Observer Program** is a vast network of thousands of weather stations across the nation. Local volunteers keep a daily climate record with data collected from equipment supplied and maintained by the NWS. San Diego's Cooperative Program Manager directs this work at over 89 official weather stations in our region. Data from some of the stations are used for hydrology and forecasting purposes. Climate data are forwarded to the National Climatic Data Center and becomes part of the official climate record.

Fire Weather forecasts are essential for fire fighting efforts by a number of agencies. Forecast responsibility was assumed entirely by the San Diego NWS office in early 2003. Routine Fire Weather Forecasts will be issued detailing sky condition, winds, relative humidity, and lightning potential. Specific spot forecasts will be given by request for particular fire fighting or controlled burn situations. Fire Weather Watches and Red Flag Warnings are issued when dangerous fire potential exists.

The **Hydrology** program provides guidance and data for forecasting rainfall amounts and flooding. The hydrology focal point works closely with NWS hydrologists, river forecasters and flood control agencies to ensure information that is correct, useful and timely gets into the hands of forecasters during possible flooding events. Networks of instrumentation such as rain gauges and stream gauges are maintained to monitor rapidly changing hydrological events. Computer models and software are developed and maintained to permit accurate and timely issuance of hydrological products such as flash flood warnings.

The **Marine** program oversees the quality preparation of marine forecasts. The Coastal Waters Forecast describes wind and sea conditions out to five days; the Surf Forecast provides details about the next day's surf. Relationships with the marine community are maintained, along with a network of coastal observation equipment for frequent observational data. Warning systems are ready to be used in the event of large surf, coastal flooding, tidal overflow, tsunamis, or severe weather of any kind over the coastal waters.

NOAA Weather Radio (NWR) continuously broadcasts a cycle of warnings, forecasts and current conditions on four separate frequencies on the VHF band, originating from our office. Specially designed receivers have the capability to alarm and play a warning at the moment it is issued. This is possible due to ever- improving computer-synthesized voice technology. Work is underway to provide Spanish language capability to radio broadcasts.

The following table includes transmitter locations, names, and frequencies:

San Diego (east of Poway)	KEC-62	162.40 MHz
Santa Ana Mountains (south of Corona)	WWG-21	162.45 MHz
Coachella Valley (east of Indio)	KIG-78	162.40 MHz
Strawberry Peak (south of Lake Arrowhead)	WXM-66	162.50 MHz

The **Public Forecast** is controlled by the management of the office. The flagship product is the Zone Forecast, the routine forecast for the masses issued at least twice daily. Forecasts of sky condition, temperatures, precipitation and significant winds are included in the forecast which extends to seven days. Area Forecast Discussions are issued at least three times a day. They give the current reasoning behind the forecast and explain any additional action taken. Quantitative Precipitation Forecasts are issued during the wet season to indicate expected rainfall amounts. Hydrologic Outlooks containing flash flood potential indices are issued during the summer thunderstorm season in the mountains and deserts. Hazardous Weather Outlooks are issued early each morning highlighting possible hazardous weather expected for the upcoming week. Any necessary watches, warnings, advisories, and other statements are issued under the direction of the Public Forecaster on duty.

The **Weather Spotter Program** is another network of volunteers. A weather spotter is a person who observes significant weather and relays the information to the NWS. With this information, forecasters can issue warnings and update forecasts if necessary in a more accurate and timely manner. Nearly 700 weather spotters are keeping an eye to the sky in our forecast area. **Skywarn** is a more proactive spotter network involving ham radio communications to relay weather information during active weather events. Spotter training presentations are held occasionally to recruit and train weather spotters.

Products Issued by the NWS in San Diego

The NWS prepares a large number of various products that provide specific information. Each product name is identified by its code containing eight or nine letters. The code formula is explained above under "Communications and Product Dissemination." For a listing of NWS products, see Appendix A. The products are organized and described in the following categories.
Note: All products originating from San Diego begin with the LAX identifier. For simplicity, the products below will be identified only by the following five or six letter code.

Climate - click on "Climate - Southwest CA" on our homepage for more information.

The **Daily Temperature and Precipitation Summary** (RTPSGX) reports the daily maximum and minimum temperatures and precipitation for numerous cities in our forecast area from a variety of weather stations, such as airports, cooperative observers, and remote weather systems. The RTP is issued at 430 am/pm and again at 530 pm largely to provide the data to local news media for early morning and late afternoon broadcasts. Updates may occur during the evening if additional data arrives. Note that these temperatures are the 24 hour high and low, which may not necessarily agree with the calendar day because thermometers are reset at the time of the 4 pm observation. This can lead to a problem. For example, let's say the high in San Bernardino was 80 degrees one day. The 4 pm report gave the high of 80 and the current temperature of 77. The next day is much cooler; Riverside and Ontario report a high of 65 degrees. The report from San Bernardino is a high of 77. Clearly, this is what we call a "carry over". The high of 77 occurred at the time the thermometer was reset around 4 pm the previous day. Stations that report once daily are susceptible to carry overs when the following day is much cooler. Other problems are more rare, but also possible. An observer may not have reported for multiple days for a variety of reasons and the thermometer would not have been reset. Also, the high temperature may actually occur after the 4 pm observation. Please take special note of the disclaimer on the product and understand that some highs that appear abnormally high may be carried over from the previous day. The **Climate Report** (CLIxxx) shows the updated climate values for the day for a number of cities in our area, with more currently being added. Daily climate reports are prepared for many sites with automated weather equipment such as: Fullerton, Santa Ana (John Wayne Airport), Ontario, Riverside, Palm Springs, Thermal, San Diego, Ramona and Campo. In the product's name, xxx represents FUL, SNA, ONT, RAL, PSP, TRM, SAN, RNM, and CZZ, respectively. Each CLI product is a daily almanac of temperature, precipitation, and several other weather conditions displayed with daily normal values, updated totals and records. These products are updated twice daily early in the morning and in the afternoon. The **Local Climatological Data (F6)** chart is a look at the current month of daily records. This is not an issued product, but is available on our web site. These are prepared for all cities for which there is a climate report (CLIxxx). At this time, only SAN - Lindbergh Field has an archive for past records, but archives will be built for the other sites. The **Monthly Weather Summary** (CLMSAN) is updated on the 1st day of each month, detailing the previous month's statistics for San Diego only. This form provides updated daily statistics for each month for San Diego. The **Record Report** (RERSAN) is a report of daily record temperatures or precipitation amounts met or exceeded at many cities in the area. Only some of the cities that report daily on the RTPSGX keep a history of daily records. Many of these cities have a short history dating back only to the 1970s. This makes the records easier to reach, and therefore less than remarkable. San Diego, Santa Ana, and Riverside are three stations with a much longer climate record.

Current Observations - click on "Current Conditions - Observations" on our homepage for more information.

The **State Weather Roundup** (SWRCA) is a collective of current airport observations all over Southern California including sky condition, temperature, dew point, relative humidity, wind speed and direction, barometric pressure and trends. When applicable, the remarks column shows very low visibilities, heat index or wind chill index values. The **Mexican Weather Roundup** (SWRMX) is a locally generated collective of weather observations from Mexico. These two roundups are updated every hour and the lists get shorter overnight as several observations do not continue. The **Coastal Weather Observations** (CGRSGX) product lists the current weather and sea conditions at several coastal stations, and is updated every three hours, but not consistently overnight.

Public Forecasts

The **Zone Forecast Product** (ZFPSGX) is the most well known and used product we prepare. It is issued at 330 am and 230 pm every day and as necessary (when the forecast does not match current or expected conditions). The **Hazardous Weather Outlook** (HWOSGX) is a product issued each morning at 6 am highlighting any expected weather in the following week that may need the issuance of an advisory or a warning. The **Short Term Forecast** (NOWSGX), also called the "nowcast", is a brief detailed forecast usually covering two hours, but no more than six hours. These forecasts appear only when significant weather is occurring such as a precipitation event. They are updated frequently as needed to provide detail not possible in the zone forecast product. The **Area Forecast Discussion** (AFDSAN) is not a forecast itself, but a discussion of the reasoning and thinking behind the forecast. A simple explanation of the general weather patterns is given in the synopsis. In the discussion portion, complex meteorological terms are often used and it is not generally public-friendly, but it contains a wealth of information about the current and future weather developments and the particular challenges involved in the current forecast. It is routinely updated three times daily, a 330 am, 230 pm, 930 pm, and other times when needed. The **Tabular State Forecast for California** (SFTSGX) is a forecast of specific temperatures and chances of precipitation for selected cities across Southern California. It is updated twice daily at 330 am and 230 pm.

The public forecast program also includes a couple of routine hydrology forecasts. The **Quantitative Precipitation Statement** (QPSSGX) is a routine forecast of rainfall amounts during the wet season, November through April. The product shows in table format expected rainfall amounts in 6-hour intervals for the first 24 hours, and 12-hour increments for the following 24 hours for numerous locations in the forecast area. The **Hydrologic Outlook** (ESFSGX) is a routine forecast during the summer thunderstorm season in the mountains and deserts, June through September. The outlook presents a flash flood potential rating in each mountain and desert zone as none, low, moderate or high. Both of these products are issued twice daily by 4 am/pm.

Non-routine Products

A **Watch** is issued well in advance when conditions are favorable for a weather event to occur that can threaten life and/or property in the watch area.

A **Warning** is issued when a weather event that can threaten life and/or property is imminent or already occurring in the warned area. Emergency Alert Systems (**EAS**) are activated for short-fused warnings, such as a Severe Thunderstorm Warning.

An **Advisory** is issued when serious conditions exist that cause significant inconvenience. It may lead to a watch or warning.

Warning and Advisory criteria are found in Appendix D.

Verification

Observed weather conditions are essential to help the NWS determine which non-routine products to issue. When warnings are issued, information is collected about weather conditions that verify the warning. With the verification data, studies can be made to learn how well the forecast team warns correctly or creates a false alarm. In this way the NWS takes responsibility for its warnings. Verification is an important part of the ongoing improvement of the warning process.

Hydrology - Floods and Flash Floods

A **Flood Watch** (FFASGX) and subsequently a **Flood Warning** (FLWSGX) are issued when a mainstem river is expected to overflow its banks. A **Flood Statement** (FLSSGX) updates a warning. The NWS defines a flood as a normally dry area inundated with water along an established watercourse such as a mainstem river. In San Diego's forecast area, the San Diego River and the San Luis Rey River qualify as such watercourses. Fashion Valley and Oceanside are the points along these rivers, respectively, for which a flood watch or warning can be issued. The **River Statement** (RVSSGX) provides specific forecast levels at Fashion Valley and Oceanside during flooding events.

Flash floods are defined as a rapid rise in water flooding a local area, followed by a rapid drop in water level. Any small stream, creek, arroyo, wash or paved urban areas can be briefly inundated by a flash flood. Dam breaks or breaches cause flash flooding downstream. When any of these are expected a **Flash Flood Watch** (FFASGX) and subsequently a **Flash Flood Warning** (FFWSGX) are issued. An **Urban and Small Stream Flood Advisory** (FLSSGX) informs of inundation conditions not threatening life and property, but can be dangerous if not taken seriously. The **Flood Statement** (FLSSGX) is an update to all of the flood and flash flood warnings and advisories mentioned above, and can contain several flood and flash flood products summarized in one product.

When large surf and/or high tides are expected to cause flooding of ocean waters causing significant beach erosion and/or property damage, a **Coastal Flood Watch** and subsequently a **Coastal Flood Warning** (both CFWSGX) are issued.

Winter Weather

All of the following winter weather watches, warnings and advisories come under the product header WSWSGX. The **Winter Storm Watch** and **Winter Storm Warning** are issued when a significant winter storm will impact the region. These detail the adverse impacts caused by heavy snowfall combined with strong winds. When the snowfall and winds are not expected to reach warning criteria, a **Winter Weather Advisory** is issued to communicate the lesser impact. If heavy snowfall is expected without strong winds, a **Heavy Snow Warning** is issued. If the snow will be heavy, but not reach warning criteria, a **Snow Advisory** is issued. When snowfall and strong winds combine to create white-out conditions and near zero visibilities, a **Blizzard Warning** is issued. When these conditions are not as severe, a **Blowing Snow Advisory** is issued. Although unheard of in Southern California, ice storms or freezing rain events would be covered by an **Ice Storm Warning** and a **Freezing Rain (or Drizzle) Advisory**, respectively. Several different winter weather hazards can be in effect at once under one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WSWSGX product.

Severe Weather

Severe weather is associated with thunderstorms, which can bring any combination of deadly lightning, hail, heavy rain (with associated flooding), and strong damaging winds. When conditions are favorable for severe thunderstorms or tornadoes, the Storm Prediction Center issues a **Severe Local Statement** (SLSCA), which becomes a **Severe Weather Watch** for Southern California in a redefining statement issued by the Oxnard office. A **Severe Thunderstorm Warning** (SVRSGX) is issued when severe thunderstorm warning criteria are met or are imminent. It is not mandatory that a local statement or a watch be in effect before a warning is issued. In fact, it is rare. When a tornado is detected by weather spotters or Doppler Weather Radar, or the forecaster strongly believes a tornado is about to develop, a **Tornado Warning** (TORSGX) is issued. Updates are made to either or both of these warnings with a **Severe Weather Statement** (SVSSGX). Flash floods occurring with severe thunderstorms are detailed in their own **Flash Flood Warning** (FFWSGX). Severe weather over coastal waters is covered by a **Special Marine Warning** (SMWSGX), which warns of waterspouts and other hazardous boating weather. Severe weather is often very localized in time and space. Accordingly, these products are very short-fused and specific.

Weather without Precipitation

A Non-Precipitation Weather product (NPWSGX) covers a great variety of weather events that do not include precipitation. This product can be an advisory, a watch or a warning. A **High Wind Watch** and subsequently a **High Wind Warning** are issued when strong winds causing potential damage are expected. A **Wind Advisory** is issued when strong winds are expected, but fall below warning criteria. A **Wind Chill Warning** and a **Wind Chill Advisory** are issued when strong winds combine with very low temperatures. When dense fog develops in more than just a localized sense, a **Dense Fog Advisory** is issued. Extremes in temperature are also covered by the product. High temperatures and humidity may warrant an **Excessive Heat Warning** when the Heat Index becomes dangerous. A **Freeze Warning** is issued when freezing temperatures present a serious threat to crops. A **Frost Advisory** is issued when a freeze is less serious.

Marine Forecasts and Warnings

The **Coastal Waters Forecast** (CWFSGX) is a forecast of winds and sea state on the coastal waters out to five days. It is issued four times daily at 230/330 am/pm and 830/930 am/pm PST/PDT. The forecast covers the coastal waters from the San Diego County shore out to five miles beyond San Clemente Island. The areas is divided into two zones by a line 30 nautical miles off the coast and paralleling the coast. The outer and inner zones may be combined when expected conditions are similar. Within the body of the forecast a **Small Craft Advisory** may be issued when winds begin to present a hazard for small vessels. The following rare warnings, **Gale**, **Storm**, **Tropical Storm,** or **Hurricane,** may be headlined when very strong winds and/or stormy seas are expected. The **Surf Forecast** is issued twice daily at 2 am/pm and contains surf and rip current information for the beaches of Orange and San Diego Counties. A **Marine Weather Statement** (MWSSGX) is a multi-purpose product. It is a **High Surf Advisory** when large and dangerous surf is widespread along the coast. The Marine Weather Statement may also describe other potentially dangerous boating or beach conditions such as non-severe thunderstorms, strong rip currents, or minor tidal overflow. When the weather over the water becomes severe, a **Special Marine Warning** (SMWSGX) is issued. Coastal flooding caused by very high tides and/or large surf is covered by a **Coastal Flood Watch** and subsequently a **Coastal Flood Warning** (CFWSGX). If a seaquake occurs along the Pacific Rim, a **Tsunami Warning** (TSUWCA) may be issued by the Tsunami Warning Center in Alaska if favorable conditions for a tsunami are met. If Southern California impacts are expected, this warning is reissued with more local details by the San Diego Forecast Office.

Aviation Products

Aviation products are coded and disseminated to the aviation community and not through the standard media to the public, but are available on our web site. A **Terminal Aerodrome Forecast** (TAF) provides detailed changes in wind speed and direction, visibility, cloud coverage, cloud ceiling height and precipitation for local airports out to 24 hours. These airports include San Diego-Lindbergh Field (TAFSAN), McClellan-Palomar in Carlsbad (TAFCRQ), Orange County-John Wayne in Santa Ana (TAFSNA), Ontario (TAFONT), Palm Springs (TAFPSP), and Thermal (TAFTRM). A **Transcribed Weather Broadcast Text** (TWB432) is the 12-hour air-route corridor forecast encompassing the route between SNA and SAN, including the mountains of San Diego County. This describes weather conditions to be expected along the route. All forecasts are updated every six hours and updated as necessary.

Fire Weather

A **Fire Weather Forecast** is similar to the public zone forecast, but gives more detail regarding relative humidity, winds and lightning potential. A **Fire Weather Watch** and subsequently a **Red Flag Warning** are issued when dangerous wildfire potential exists, i.e., when strong winds combine with low relative humidity. Spot weather forecasts, which are site specific for wildfires or controlled burns, are issued upon request from fire fighting agencies. The San Diego Forecast Office recently assumed these responsibilities in January 2003.

News Products

A **Special Weather Statement** (SPSSGX) is a description of an upcoming significant weather event, such as a winter storm. It is usually allowed to expire once the weather event is occurring and is covered by a warning or advisory, such as a Winter Storm Warning. The Rainfall Storm Total Summary (RRMSGX) is a periodic update to storm precipitation totals during a given storm. The **Local Storm Report** (LSRSGX) is issued soon after an intense weather event has produced injury, death or damage, documenting the place, time, and impacts of the event. Several reports may be issued after the same event as more information becomes available. A **Public Information Statement** (PNSSGX) is a multi-purpose news product. Its information can range from a summary of a weather event, an update to new technology, a change in the format of a product, a change in local policy, or other purposes.

Weather Safety and Preparedness - Click on "Weather Safety - Preparedness" on our homepage for more information.

The primary mission and responsibility of the National Weather Service is to protect life and property. The goal is to warn for all potentially dangerous weather events with sufficient lead time so emergency personnel and the public can take action to eliminate or minimize the impact. However, for many reasons a dangerous weather event may strike without a warning being issued, or the public may not be otherwise prepared. Weather awareness and preparedness are vitally important especially in our region where residents can become complacent because dangerous weather is relatively infrequent.

When a warning is issued initially, the **Emergency Alert System** (EAS) is activated. Local news radio stations with this responsibility receive this alert of three tone bursts and proceed to broadcast the warning over their station. In our area KOGO 600 AM Radio is the primary EAS activator. On television the warning message scrolls across the bottom of the screen. NOAA weather radios broadcast the warning direct from the NWS office (specially designed receivers kick on automatically when a warning is issued). The NWS - San Diego web site will indicate the warning on color coded maps. Sadly, these efforts are sometimes not sufficient to inform all endangered parties in a timely fashion. We encourage all residents and visitors to become aware of the potential weather dangers associated with the area in which they live, work, and visit, and to prepare accordingly. See Appendix E for weather safety information.

Behind The Forecasts

Terminology and Forecast Language

The NWS has a unique way of describing expected weather. Some of the terms used to describe time periods and weather conditions may seem arbitrary, but there are rather specific meanings attached to them.

Time Periods

Time Period	Definition
today	sunrise to sunset
tonight	sunset to sunrise
morning or in the morning	sunrise to noon
afternoon or in the afternoon	noon to around 6 pm
evening or in the evening	from 6 pm to midnight

In the Zone Forecast Product the first three days are divided into both day and night periods. A night period crosses over midnight as outlined above. Days four to seven are mentioned only as days, but are defined as calendar days from midnight to midnight. For example, in the short term (within three days) "Sunday night" means from sunset Sunday evening until sunrise Monday morning. Lows for Sunday night most of the time would technically occur early Monday morning before sunrise, but are mentioned in the Sunday night period. In the long term beyond three days, "Thursday" means exactly Thursday from midnight to midnight. Low temperatures in this case most often will refer to lows early Thursday morning before sunrise.

Sky Conditions

Sky conditions are described depending on how many tenths of the sky is covered by opaque clouds (clouds that completely block the sun).

clear or sunny	less than 1/10 opaque clouds
mostly clear or mostly sunny	1/10 to 2/10 opaque clouds
partly cloudy	3/10 to 6/10 opaque clouds
mostly cloudy	7/10 to 8/10 opaque clouds
cloudy	9/10 to 10/10 opaque clouds

High cirrus clouds are often somewhat transparent, so even if the sky is full of them the term mostly clear or partly cloudy may be used. In contrast, a small patch of fog can entirely obscure the sky from an observer's point of view. It may be cloudy or foggy at that point, but only a mile or two horizontal distance away the skies are completely clear. That patch of fog is so low it is below the horizon from an outside observer's perspective. This is often the case with varying terrain, a shallow marine layer, and dense fog. Fog may persist at the beaches while only a few hundred feet inland it is clear. Forecasters attempt to include language to specify the range of possibilities, but cannot describe every possibility without becoming entirely too wordy. A mostly sunny forecast may be a bad forecast to the few people underneath a tiny isolated patch of fog, but a correct forecast to the other 99% of the population. By contrast, high clouds can be seen hundreds of horizontal miles away.

Winds

Wind direction is always given **from** which the wind is blowing (e.g., a northwest wind is a wind coming from the northwest). Wind speeds are given in miles per hour. Terms that may be used to describe wind speeds are defined in the following table.

0-5 mph	light or light and variable
5-15 mph	none used
15-25 mph	breezy (for mild weather) brisk or blustery (for cold weather)
20-30 mph	windy
30-40 mph	very windy
40 mph or greater	strong, damaging, dangerous

Since winds are highly variable in time and space, usually the strongest winds expected anywhere in the zone are mentioned. For people in areas normally protected from the wind, this understanding is important. "Local" is a term often used to imply that indicated winds will not blow over the entire area, but at some unspecified locations that may differ in time and space. Often, winds are influenced by terrain creating a predictable wind pattern. If there is enough confidence about exactly where and when the winds will take place, a better description is given. Phrases such as "mainly through and below passes and canyons in the morning" are often included to add beneficial detail.

Temperatures

Temperatures are often given in ranges such as "upper 60s to mid 70s", but for brevity simple numerals such as "42 to 50" are also used. Here is what we mean with some of the described temperature ranges:

Described as...	Means...
Near 40	38 to 42
around 85	a range from 83 to 87
lower 50s	temperatures of 50, 51, 52, 53, 54
mid or middle 70s	temperatures of 73, 74, 75, 76, 77
upper 30s	temperatures of 36, 37, 38, 39
60s	60 to 69

For example, "mid 50s to mid 60s" means 53 to 67. In numerous weather situations temperature ranges can be very large; a forecast of the entire range would not be useful, and a detailed description would be too wordy. Extreme temperature outliers are simply left out of the range and the forecast is made for the majority of the area. For example, on a clear morning in the San Bernardino Mountains outlier low temperatures may be 29 degrees in a high mountain valley and 51 degrees on a foothill slope. A forecast covering that entire range ("upper 20s to lower 50s") is not very useful, so a judgement is made that most lows within that zone will be in the mid 30s to mid 40s. This is a more useful and brief forecast. Observers over time will come to know where their location fits with respect to the standard forecast ranges.

Precipitation

The idea to use probabilities for whether it was going to rain began with the National Weather Service in 1965. The original concept was to provide a risk-benefit assessment for people to whom the occurrence of rain was critical. For example, a contractor might decide to pour concrete if the chance of rain is only 30 percent, but he might decide not to pour if it's 60 percent. **Probability of Precipitation (PoP)** is the likelihood (expressed as a percent) of measurable liquid precipitation (or the water equivalent of frozen precipitation) during a specified period of time for any point in the forecast zone. **Measurable precipitation is defined as 0.01 inch or more.** PoPs accompany **expressions of uncertainty** or **areal qualifiers** within the forecast narrative. For example, a slight chance of rain (20%) is an expression of uncertainty that means at least one location in a zone should receive measurable precipitation 2 out of 10 times (20%) given a similar weather situation. Or, to state the converse, rain is NOT expected 8 out of 10 times. The probability has nothing to do with the amount of rain, how long it will rain or the percentage of the area that will get rain. When showers are mentioned in a forecast, there is a high likelihood of them occurring somewhere in the area, and thus the probability refers to the amount of the area in the forecast that will get wet, and receive an areal qualifier. "Scattered showers" means that 30 to 50 percent of the zone's area gets hit by at least one shower and receives measurable precipitation. Below is a table of these two descriptive methods and their relationship to PoPs.

PoP Percent	Expression of Uncertainty	Equivalent Area Qualifiers
10-20 percent	slight chance	isolated
30-40-50 percent	chance	scattered
60-70 percent	likely	numerous (or none used)
80-90-100 percent	(none used)	(none used)

Other qualifying terms may be used with the above non-numerical expressions.
Terms of duration: brief, occasional, intermittent, frequent
Terms of intensity: Very Light: less than 0.01 inch per hour
Light: 0.01 to 0.10 inch per hour
Moderate: 0.10 to 0.30 inch per hour
Heavy: greater than 0.30 inch per hour
For trace events (precipitation of less than 0.01 inch), the terms "drizzle," "light rain" or "sprinkles" will be used, often with a PoP of 10%. Our marine environment can bring dense fog (which can be very misty), heavy condensation, and drizzle. Most of the time these marine layer precipitation events result in a trace, even when road surfaces become completely wet. For more on the philosophy of probabilities, check out the Uncertainty section under Forecast Challenges below.

Forecast Tools

Today's forecaster has a large variety of tools available. Many advances in technology and the understanding of meteorological principles in recent decades have added a great deal to the science. Seven day forecasts today are more accurate than three day forecasts were 20 years ago. Meteorologists blend their own knowledge and experience with the data provided by these tools to make a forecast.

Satellite

Satellite data is one of the more essential forecasting tools. The satellite in use over the western U.S. is the GOES - West Satellite. This satellite is geostationary, meaning that it rotates along with the earth so that it is always over the same place on the earth. Three basic images are generated from this satellite: visible, infrared and water vapor imagery. Polar-orbiting satellite data are also used. These satellites orbit the earth crossing the poles. Several additional specialized images are also available.

Visible imagery is like a camera snapshot from space, recording reflected visible light from the earth's surface. All clouds are white. The image goes black as the sun sets. Since all clouds are white, it is sometimes difficult to tell at what levels these clouds exist. **Infrared** images are actually measurements of temperature, rather than reflected light as in visible satellite images. Warmer objects appear darker than colder objects. Cloud temperatures are related to cloud height, and relative cloud height can be readily inferred. **Water vapor** images are useful for pointing out regions of moist and dry air. Dark colors such as black and dark grey indicate dry air while bright colors such as white or light grey indicate moist air. Swirling wind patterns in low pressure systems and jet streams are easily identified. Other derived satellite products have been developed, such as the **fog** product. In San Diego this is commonly used at night to easily detect very low clouds and fog common to our region. For more background on satellite imagery, click on: **www.srh.weather.gov/jetstream/remote/satellite.htm**.

Radar

Doppler Weather Radars were installed during the early 1990s and marked the beginning of a new era in detecting and forecasting weather. The official name is **NEXRAD WSR-88D**, meaning NEXt Generation Weather Service RADar-1988 Doppler. Technicians at the San Diego office maintain two Doppler radars: one east of Scripps Ranch in San Diego, and one in the Santa Ana Mountains near Corona. While some media outlets claim Doppler radars as their own, only the National Weather Service owns and maintains weather radars in our area. In addition to detecting areas of precipitation called **echoes**, the Doppler Radar also detects movement and intensity of the precipitation. The radar also detects wind velocity and direction, useful for detecting rapid shifts in wind direction, including tornadoes. These data alert forecasters to the possible need of warnings or advisories.

How does it work? The radar sends out a beam of energy that strikes an object. Some of that energy is reflected back to the radar. The velocity of the object can be derived from the phase change of the beam's wavelength as it returns to the radar. The radar has many limitations. Due to occasional atmospheric conditions, the beam is bent toward the ground and detects ground effects (hills, trees, structures) called "clutter." The beam scans the atmosphere in slices, one angle at a time. As the beam angles upward, the beam may be over 20,000 feet high at a distance beyond 100 miles. Significant weather can occur below the beam completely undetected. In addition to raindrops and ground effects, the radar can detect birds, insects, dust, etc. Military operations often include spreading **chaff** (tiny, fine metal strips) into the atmosphere. Chaff is a wonderful reflector for the radar beam and shows up on the radar display as an intense radar echo. Often, a quick look at the satellite image can help verify that this is not precipitation. Echo signatures of chaff look quite different in appearance than actual precipitation and can be easily identified by the trained eye, but it becomes more difficult when echoes of legitimate precipitation are also present. For more information about Doppler Radar, click on **www.wrh.noaa.gov/radar/radinfo/radinfo.html** and **www.srh.weather.gov/jetstream/remote/doppler.htm**.

Observations

Surface observations are current weather conditions measured at a point on the earth's surface. The most reliable and accurate source of hourly weather observations are automated surface observation systems, called **ASOS** stations, a network of standardized equipment funded and maintained by the NWS. This equipment, usually located at airports, transmits at least one hourly observation called a **METAR** (METeorological Aviation Routine weather report). METARs are written in METAR code, an international weather descriptive code.

A network of **ALERT** (Automated Local Evaluation in Real Time) equipment is used primarily for hydrological purposes, measuring rainfall and river levels, but also temperature and wind in some cases. This equipment is maintained by flood control agencies in cooperation with the NWS.

Another network of weather instrumentation is **RAWS** (Remote Automated Weather Station) data, used primarily for fire weather forecasting support. The network is maintained by several other federal and state agencies, such as the California Department of Forestry and the Bureau of Land Management.

A large variety of **other weather data** sources are available, mainly on the Internet. These include school networks, resorts, businesses and private citizens with weather equipment. We use these sources only as a last resort and with caution due to their occasional low levels of accuracy and reliability.

Upper Air Observations provide valuable data. Forecasters need to know the behavior of the atmosphere in three dimensions, not just at the earth's surface. Observations of the upper air are taken by weather balloons with an attached radiosonde, a small packet of weather instruments. Radiosondes transmit the observed weather conditions as the balloon rises. The data is collected by radio receivers on the ground and plotted as a vertical trace called a **sounding**, on a thermodynamic diagram called a "Skew-T." This snapshot of temperature, dew point and winds in the atmospheric column is a most valuable set of data. A forecaster can identify temperature inversions common to our region, levels of instability and moisture, changes in wind speed and direction, and infer many other atmospheric behaviors. These balloons are launched the world over at 00z and 12z universal "zulu" time. In this way the world is synchronized with an accurate 3-D picture of the weather conditions twice a day. These data are among the most important input to computerized numerical weather models. However, the sounding network is rather sparse and soundings are taken only twice a day. In California soundings are taken at Miramar MCAS, Vandenberg AFB, Oakland, and occasionally Edwards AFB.

Satellite Sounders are becoming more adept at correctly inferring temperatures and winds at all levels of the atmosphere from GOES Satellites. Some of these data are becoming more included as input into computer model guidance.

Wind Profilers are surface based instrument grids that detect winds and temperatures in the atmospheric column. Most of these are maintained by the military, universities or other research institutions.

ACARS (Aircraft Communication Addressing and Reporting System) data are vertical traces of weather data taken by commercial airliners during ascents out of and descents into major airports. The frequent observations are valuable because they often fill in the time and space gaps between weather balloon soundings.

Forecast Models - Numerical Model Guidance

Once meteorologists have an accurate picture of the current atmosphere, the process of forecasting can begin. Scientists through the ages have come to understand some of the movements of the atmosphere through the study of physics, fluid dynamics, and thermodynamics. Mathematical equations called equations of motion have been developed to describe the movement of air in the atmosphere. By modifying these equations, removing the less important components, and inserting the weather data into the equations, a solution can be given for a future time. For example, if we know the temperature for a certain place at midnight, we can enter that value into the equation to get the temperature for that place at noon. This can be done for many time steps (i.e. 24, 36, 48 hours) into the future. These equations of motion are non-linear, meaning they cannot be solved by hand in a timely fashion; the weather event would occur before we could produce a forecast for it! This is why powerful computers are essential. The computer can make iterations, a long sequence of approximations which increasingly get closer to the solution. After numerous iterations, a solution arrives. The process is repeated for every weather parameter and for every grid point on the map. It works like baking a cake:

Data is collected: upper air, satellite, radar, surface observations, etc.	*Ingredients are gathered.*
Data is input into mathematical equations of motion to be solved by powerful computers.	*Ingredients are mixed and put in the oven.*
The computer generates a numerical solution in future time steps.	*The cake is baked.*
The solutions are checked for quality and plotted graphically on maps.	*The warm cake is sliced and served.*

In its finished form, the numerical model data arrives at each forecast office a few hours after the “run time”: 00z, 06z, 12z, and 18z universal time (a few localized models are run more frequently, but do not extend very far into the future). The data is ingested by AWIPS equipment available to the forecaster to analyze and formulate a forecast. It comes in graphical format or statistically generated text format.

Some guidance is received from national or regional centers regarding rainfall amounts, flooding and flash flooding potential, severe thunderstorms, hurricanes, etc. For example, if a big storm is coming and we need to figure out how much rainfall we’ll get, the San Diego office will receive guidance from the Hydrometeorological Prediction Center (HPC) in Maryland and the River Forecast Center (RFC) in Sacramento. They will provide valuable input for deciding how much precipitation will fall and what flooding impacts may occur. The Storm Prediction Center (SPC) in Oklahoma provides guidance on the probability of severe thunderstorms. In the end, the final decision and forecast rests with the forecasters in our office.

Advanced Weather Information Processing System (AWIPS)

Installed in San Diego in April 2000, AWIPS provides one-stop shopping for weather data used by the forecaster. Numerical model guidance, satellite imagery, radar data, and analyses can be viewed graphically. AWIPS offers the capability of viewing the model guidance in a variety of ways to get a four-dimensional understanding of the atmosphere's behavior. NWS alphanumeric guidance, observations, and text products nationwide are available.

Interactive Forecast Preparation System (IFPS)

IFPS is the software forecasters use for preparing and issuing forecasts as of November 2002. With this new system, forecasters manipulate a high-resolution gridded database that represents the expected weather, rather than writing text. IFPS then generates a suite of text, graphical, and gridded forecasts from the database. The main improvement is the greater degree of temporal and spatial detail available in the forecasts, with additional weather elements, such as relative humidity and rainfall amounts.

Forecast Challenges

Regarding Southern California weather, some observers may joke, "What weather?" Our climate and our profession have often been the target of jokes (e.g., "why don't you get a real job?!", "if I were as wrong as often as you are, I'd be fired!" or "is this where they send the junior meteorologists?"). It is true that our climate does not suffer the extremes of temperature, wind, and precipitation that many other climates do. The challenge of predicting our weather lies in the uncertainties, subtleties, and relatively infrequent extremes, not often in the severity. However, an enormous population base unfamiliar with severe life-threatening weather is less prepared for it when it comes, and that presents a new risk. Simple drizzle or light rainfall can be a killer. Compare traffic accident reports in Southern California when it rains with those reports when it does not rain, then look at the same figures for Seattle. Additionally, expectations differ with professions. A surgeon is expected to be perfect or very near perfect all the time, but baseball players are considered great when they successfully get a hit with only one third of their attempts. Stock market analysts are much less accurate and far more ambiguous than are weather forecasters. The public's expectations of weather forecasters are either too high (believing they should always be correct) or too low (getting burned by a bad forecast or the incorrect interpretation of a good forecast and never again trusting forecasters).

Despite popular belief, forecasting the weather in our region is not as easy at it seems. There are a number of questions to answer and puzzles to solve each day. These puzzles may be as innocuous as determining when the coastal clouds will clear or what the high temperature will be, but most of the time there are more significant issues. These issues are included in the **forecast discussion**. Reasons, opinions, clarifications, and expressions of model performance and preference are included. Formerly, these discussions were meant only for coordination purposes within the NWS meteorology community and transmitted through equipment that required extreme brevity. For these reasons, many complex meteorological terms, abbreviations, contractions, and jargon were used. In recent years discussions have become much more public (and posted on the Internet) and have become much more readable for non-meteorologists. One who reads the discussions day after day will quickly gain an understanding of the particular challenges the forecasters are facing, even when the weather is benign. The latest discussion can be found on our web page at: **www.wrh.noaa.gov/sandiego/LAXAFDSAN**.

Uncertainty

"To the often-heard question, 'Why can't we make better weather forecasts?' I have been tempted to reply, 'Well, why should we be able to make any forecasts at all?' "
- Edward N. Lorenz, MIT researcher, in *The Essence of Chaos*.

Chaos Theory is very real in meteorology. The tiniest errors in the initial conditions become very large errors in the solution. If a computer model does not initialize well, it is like a golf club swinging through the ball at an angle only slightly off perfection. The result, as many golfers know, is a large error in where the ball ends up.
Some uncertainties in our forecasts arise because of the lack of essential information. With our current knowledge and technology, it is impossible to account for all the possible variables that impact the weather. Our data networks may not be dense enough to detect some significant local effect. The leading researchers in the field may not have discovered the meteorological theory behind an event and forecasters may not even understand everything that is actually taking place. The forecaster may not be fully aware of the situation or sufficiently experienced to detect something important. Sometimes the weather simply defies explanation, or at least an explanation we can come up with. For example, if we look at two identical weather patterns with the same dynamics, moisture, temperature profile, structure, etc., we often see different results, like rain with one system, but not the other. We often ask how and why. After the event we can speculate on why it rained or didn't rain, and even come up with an acceptable explanation, but that's after the fact. We keep that in our records and in our brains for future reference. If the event is rather significant, we may even collect the data surrounding the event, analyze and study it in depth, and write and publish a paper as a case study.

Our climate and global position add to the uncertainty in our forecasts. San Diego is located just far enough south to be on the southern edge of the normal winter storm track. We may be on the edge of the area of expected rain. Promising weather systems may not maintain strength as they approach us. The weather system may bring local showers where some spots measure rain while the rest of the area remains dry.

Models.wav

Comparisons of satellite data to model guidance can be done on AWIPS to determine the quality of the guidance. This is called model initialization. For example, if the model guidance at 00z does not match closely to the observed atmosphere (model data and observations are overlaid on a satellite image) at 00z, then the initialization was not good. The forecaster may conclude that since this particular model does not have a good handle on the weather pattern, there is no way it will have a good handle on it in future; the forecaster will then discount or ignore its solutions. The model guidance may give us different solutions with each new model run, or the models' solutions differ with each other. When the models seem to disagree from run to run and/or with each other, forecaster confidence lowers. At times with a particular feature such as a storm, the models are very tardy to come into agreement, perhaps less than one day before the storm. When the confidence is low, the forecaster relies more on experience than the guidance, and as a result the forecast may become less specific.

In contrast to our challenges, the Seattle forecaster has it relatively simple: A storm approaches, forecast rain. It is only a question of when and how much. Many local folks demand that we could be so certain: “Just tell us, is it going to rain or not?” The science of meteorology is young. Many discoveries in meteorology theory and improvements in numerical model guidance are taking place, but there are still numerous hidden variables or nuances that can go undetected and change the weather. Our efforts to correctly define atmospheric motion in real time are clumsy at best. The NWS prefers to avoid giving an irresponsible and possibly misleading forecast of certainty when no such certainty exists. This is why we use terms of probability. The following true example is illustrative. One day the NWS issued a forecast with a 40% chance of rain for the next day. When the next day arrived, a radio personality reported rain where he was and questioned on the air: “Does this mean that the chance of rain was really 100%?” No. If we were to flip a coin, we know the chance of it coming up heads is 50%. If it comes up heads, it does not mean the chance of coming up heads before the coin flip was 100%. The chance is again 50% before the next coin flip. Failure of the broadcast media to grasp the probability concept can unintentionally change the meaning of the forecast that much of the public receives. Broadcasters are often heard to report a chance of rain, or even a slight chance, as “rain in the forecast,” significantly altering the meaning. It is human nature to add certainty where there is little.

misunderstand.wav

Forecasts can be misinterpreted or trusted too much. “A chance of showers” would have been a good forecast if only some areas get measurable rain (in the radio personality example above, the shower he experienced may have been the only one in the area). “Mostly sunny” is a good forecast if most coastal areas are sunny, even if a few beaches experience fog all day. “Locally windy” is a good forecast if a few spots are windy, even if most areas are not. Conditions change in both time and space. “Partly cloudy” may mean mostly cloudy at times or mostly sunny at times during the day, but for brevity’s sake the forecaster chose to simplify the wording. With the common low clouds, it may be completely cloudy in some spots and completely sunny in other spots, then the reverse occurs, all within the same zone; for this, “partly cloudy” might be appropriate forecast wording as well. It should also be remembered that forecasts are refreshed often. A forecast is routinely issued every 12 hours. Often, the forecast is updated between those routine issuances. By the time the morning newspaper reaches your door, there may already be two or three updates made to the forecast you are reading.

Forecasts for future time periods become more and more uncertain with each future forecast day. In 2001 the NWS began issuing seven-day forecasts as part of the routine public forecasts, up from five days previously. On average, NWS forecasters accurately predict the next day’s weather 90% of the time. Today's four-day forecast is as accurate as the two-day forecast was in 1985. The accuracy deteriorates as the forecast goes further out; the day seven forecast is just over 50% accurate. Beyond seven days, let’s be frank, the forecast is a flip of the coin. Some extended models can indicate which way to lean. Actually, the climatological normals become the best forecast beyond one week. When someone calls requesting a forecast for an outdoor wedding two months away, we give them the climatological normal high, low, and chance of rainfall for the date.

Long Term Prediction is fraught with uncertainty, but significant advances have been made in understanding the global climate and today there are more data available for analysis. In recent decades the weather altering mechanism **El Niño** has been a catalyst for these advances (for more on El Niño, see "The Weather of Southwest California - A Climate Overview" below). The **Climate Prediction Center** is a national agency and world leader in climate studies and long term predictions. They produce monthly and seasonal outlooks for the entire country. The outlooks are not exactly forecasts, but graphical expectations of whether temperature and precipitation will be above normal, near normal, or below normal. Sophisticated climate models take into account all important effects on global weather such as sea surface temperatures, pressure patterns, upper level winds, and the greenhouse effect.

Scarce Data

West and south of California lies the vast, open Pacific Ocean. There are a few buoys and ship reports, but it is largely devoid of data. To the south and east is Mexico with very few reliable data sources. Because much of our weather comes from the west or south, it is difficult to know just what kind of weather is headed our way. By contrast, most of the country has the advantage of looking west and learning exactly what kind of weather is headed their way. An old axiom states that if you want to know what weather to expect in New York City tomorrow, just look at the weather in Chicago today. The lack of upstream observations hurt California in another way. Numerical model guidance depends on initial data to get a correct start on the forecast. With very few data points over the ocean, the model has only a vague idea of the weather conditions before they reach land. Accordingly, the model often has trouble ascertaining the strength, position and/or timing of approaching weather systems. Yet another problem arises. Several model domains (areas covered by the model) have a western boundary not far out to sea. So some models do not "see" a weather system very well before it enters the domain. Once it sees the system, it may struggle to correctly represent and define it before it reaches land.

Even in our highly populated area with numerous data points, there never seem to be enough data points when they are most needed. That is because many weather phenomena are highly localized and very brief. California tornadoes are a good example of this. It is nearly impossible to forecast a Southern California tornado before it touches down. The Doppler Radar scans a slice of the atmosphere every six minutes at each beam angle. A tornado can touch down, do its damage and lift back into the cloud in much less time than the six minutes between radar scans. Additionally, a tornado may be distant from the radar and occur below the beam, and go undetected. Doppler Radars were built and tested for the severe weather of the plain states and are more attuned to detecting those larger scale severe storms. Luckily, California tornadoes are usually not as severe or damaging as those in the Midwest. In an effort to better detect these localized weather phenomena, we have nearly 700 volunteer weather spotters across our region who help us fill in the gaps in data. We also appreciate it when the media pass along a significant report to us.

Microclimates

Microclimates are very small scale climate zones. Southern California's highly complex terrain and proximity to the ocean help create a variety of microclimates. The weather can be very different between canyons and mesas, beaches and inland areas, mountain valleys and mountain slopes, urban and rural areas, and a number of other variables. On a clear night, overnight low temperatures may be 15 degrees lower in a canyon compared to a neighboring mesa. On a sunny day, high temperatures may be 15 degrees lower at the beach compared to the reading only a few miles inland. Winds may be strong through certain corridors, while neighboring areas are nearly calm. A mountain area may receive significantly more precipitation from a storm than that received in the valley at its foot.

These microclimates present a problem in forecasting the kind of detail that many users want. The forecast zones help to categorize the different weather expected for different areas, but even within the zone it is difficult to describe all weather elements spatially and temporally in detail. The new IFPS (Interactive Forecast Preparation System) is a grid based interface which can offer this kind of detail. It is a robust change to the way the NWS makes forecasts. Now a user is able to get a very detailed forecast for their exact location and how the weather will change throughout the day.

The Weather of Southwest California: A Climate Overview

Climate Zones

Most people visualize the mild coastal climate when asked about the climate of Southern California, forgetting for a moment that there are coastal, inland, mountain and desert climate zones that are highly distinct and very close together. These climate zones are determined by the effects of proximity to the ocean, terrain, elevation and latitude. Using the Koppen system, the more populated areas of Southern California have a Mediterranean climate, characterized by mild, sometimes wet winters and warm, very dry summers. The climate types in the mountains range from Mediterranean, to Subtropical Steppe (not as mild as Mediterranean with more precipitation in all seasons) to Highland (more extreme and variable due to elevation). Desert climate types include Midlatitude Desert, a dry climate with hot summers and cool winters, and Subtropical Desert, relatively hotter and drier. The Mediterranean climate includes all coastal areas, valleys and foothills. Subtropical Steppe climates would include the mountains between the foothills and the higher peaks. Highland climates would encompass the mountain tops, probably above 7,000 or 8,000 feet.

Annual precipitation amounts increase gradually from the coast to the mountain crests, then drop dramatically into the deserts. A graphic of average annual rainfall can be found on the following web site: **www.wrh.noaa.gov/sandiego/climate/pcpn-avg.htm**. California owes its agreeable climate to a semipermanent high pressure area located over the eastern Pacific Ocean, which deflects storms northward and secures fair weather for the region. During the winter months, this high breaks down allowing the jet stream to steer midlatitude weather systems along a more southern track of the prevailing westerly winds. For this reason, most precipitation comes from winter storms between November and March.

Winter Storms

Winter storms bring a great variety of weather phenomena: strong winds, flooding rains, heavy snows, large surf, and thunderstorms with their damaging lightning, hail, winds and the occasional tornado. In Southern California, cold fronts arrive with little resemblance to those described by weather textbooks. The cold air associated with deep troughs of low pressure becomes modified by the mild ocean waters and the front becomes less distinct. Winter storms usually have a leading band of rain ahead of the colder air of the system. With the warmer storms, the majority of the rainfall occurs in these initial bands. Cold storms bring a pool of cold unstable air aloft that follows behind the initial rain band, bringing showers and/or thunderstorms. In these colder storms the majority of precipitation often falls from the showers and thunderstorms rather than the initial band of rain. At times there is a high variability of rainfall distribution. For example, a big winter storm may bring three inches of rainfall to Anaheim, but less than an inch to San Diego. In showery situations, one thunderstorm can drop over an inch of rainfall over one spot, leaving the rest of the area dry. The direction of flow of the lower level winds can indicate favorable areas for more rain than others. If the flow is south or southwest, we expect relatively greater rainfall in Orange County, the northern Inland Empire and especially the San Gabriel and San Bernardino Mountains. West or northwest flow will bring greater rainfall to San Diego County.

On rare occasions, the subtropical jet stream can direct warm, wet air into California originating from the central Pacific. This stream of moist air is sometimes called the Pineapple Connection or Pineapple Express, because the track often comes from the direction of Hawaii. The air has a greater amount of moisture than the air contained in colder storms, so they tend to bring heavy rain, but little if any snow. When the long wave pattern, or general global circulation, steers this moisture into our region, a wet pattern develops and there can be many days of rainfall. Once the soil becomes saturated, most of the rainfall immediately becomes runoff, which causes flooding and flash flooding. If the rainfall is intense enough, such as in heavy prolonged thunderstorms, the soil need not be saturated, as the water will run off regardless and produce flash floods. Strong winds accompany especially strong winter storms and can cause damage particularly along the coast and in the mountains.

The phenomenon of **El Niño** makes its presence known during winter by altering the traditional path of the jet streams and directing frequent storms into California. With the presence of a strong El Niño, the subtropical jet stream becomes oriented over California, carrying large amounts of warm moist air into the region. Occasionally, the polar jet stream brings a cold front that coincides with the subtropical jet stream and produces massive amounts of rain. Any strong individual storm during the wet season can bring disaster, but the real problem with El Niño comes from the *frequent arrival* of strong storms. They simply continue to exacerbate the problems left by the previous storm(s) and do not allow enough time for people or the environment to recover.

A storm originating from the Gulf of Alaska or Canada obviously will have much more cold air associated with it than a storm from farther south. Cold air aloft contributes to instability, a strong decrease between surface temperatures and temperatures aloft. If instability is great, thunderstorms develop. On occasion these thunderstorms are severe, meaning there is some combination of intense flooding rain, large damaging hail, and/or strong damaging wind.

Thunderstorms pose a number of problems. They bring intense rain, which can cause flash flooding.

They contain lightning, hail and very strong wind gusts, which can kill or injure people and damage property and crops. Thunderstorms also develop in warm air masses when tropical moisture is introduced from the southwest monsoon or a decaying tropical cyclone. A thunderstorm is considered severe when winds are strong enough and hail is big enough to produce damage.

Winter storms also bring snow mainly to the mountains. One strong storm can bring a few feet of new snow to the higher mountains. While most Southern California residents do not have to worry about snow at home, we do often have to drive through winter conditions to leave the region. On very rare occasions, an especially cold storm can drop the snow levels to some of the densely populated lower elevations.

When the atmosphere is moist and unstable, convergence of the air at lower levels can produce lines of rising motion called convection. This convection is a circulation of air in the vertical plane and can produce showers and thunderstorms. Topographical barriers such as islands or mountains can induce these convective lines in the proper conditions. Low level winds flow around islands or mountains and converge on the lee side like water in a stream flows around rocks and converges on the other side. As the air converges, the air is forced upward because it cannot sink into the ocean or the ground. The result is a line of convection containing showers and/or thunderstorms parallel to the mean flow extending downwind. We call this lee side convergence. A similar thing happens as a result of the mountains. Zones of convergence can occur on the lee side of mountain ranges between two valleys or mountain passes. For example, air flowing around the Palos Verdes peninsula can produce a line of convection from Long Beach into northern Orange County. This area is also Southern California's "tornado alley." Winds flowing around the Santa Ana Mountains form the "Elsinore Convergence" from Lake Elsinore to Hemet. Smaller similar convergence zones can develop on the north and east sides of all the mountains from Victorville to Mexico.

Winter storms also bring large ocean swell, which translates into large surf. In addition to the obvious dangers for beach visitors and water sports enthusiasts, tidal overflow and erosion of sand and coastal bluffs present many more dangers to life and property.

The Summer Monsoon

The Southwest Monsoon season occurs from mid June through mid September over the southwestern U.S., generally more prominent from Arizona eastward. Occasionally, episodes of monsoonal flow reach Southern California during late summer and bring thunderstorms (sometimes called "Sonoran" storms) mainly to the mountains and deserts.

The monsoonal flow develops as a strong upper ridge builds over the four corners region, which draws warm moist air from Mexico into the Southwest. Perturbations or disturbances in this flow such as an easterly wave trigger convection and thunderstorms. An easterly wave is an inverted low pressure trough within the monsoonal flow that moves from Arizona or Sonora westward into California. At times moist air flows northward from the Gulf of California (Sea of Cortez) further destabilizing the atmosphere. This is called a **gulf surge**. At times, even when the monsoon is absent, the moist air layer of the gulf surge is rather shallow and does not produce thunderstorms; it becomes a sort of hot, humid, desert marine layer. For thunderstorms to develop, the moist air moving into the region needs to be rather deep in the atmospheric column. The heating of the earth's surface further destabilizes the atmosphere and convection results; columns of locally heated bubbles of air rise in the moist atmosphere and grow into towering cumulonimbus clouds and thunderstorms. Sometimes the monsoonal flow spreads a shield of opaque cloudiness over the region. When this happens, convection may be inhibited because the sun is not able to effectively heat the earth's surface and sufficiently destabilize the atmosphere.

In the mountains and deserts, the air from the surface to the cloud level is usually very dry. As the thunderstorm produces rain, the drops fall into this drier layer and may completely evaporate (if falling rain does not reach the ground, it is called **virga**). This evaporation cools the column of air. Because cool air is more dense than warm air, the cool air in the warm environment will sink and accelerate as it descends. This **downburst** of air can reach the ground with damaging force. A highly localized downburst is called a **microburst**. Upon impact with the ground, the winds rapidly spread across the earth's surface as a **gust front**. Some gust fronts, or outflow boundaries, can converge with neighboring thunderstorm outflows. These colliding gust fronts can create new lines of convection.

Flash flooding in rough terrain can be very deceptive. A mountain thunderstorm can flood desert areas with water, mud and rock, even if no rain falls in the desert. Flash floods in areas of steep terrain, impenetrable rocky soil, and little vegetation are the most volatile.

Normally, monsoon thunderstorms are relatively rare west of the mountains, but can occur under the right conditions. If the winds from the mountain top level upward are rather strong from the east or southeast, thunderstorms can drift from the mountains to the valleys and even, in rare cases, to the coast.

The Marine Layer

The marine layer is perhaps coastal Southern California's most dominating weather feature. Proximity to relatively cool ocean waters protects the region from extreme heat or cold. Air at the surface cools by conduction as it comes in contact with the water. When the air above the water is warmer than the water, as it is normally for all seasons except winter, a temperature **inversion** develops. In a normal atmosphere, air temperature decreases with height. An inversion means temperature increases with height through a layer; it is the *inverse* of the standard atmosphere. Cool and moist air is at the surface (in contact with the water) and warmer, drier air is above it. The air is cooled enough to condense and form a stratus cloud layer.

Basic weather knowledge includes understanding of land-sea interactions. During the day the sun warms the land more efficiently than the ocean due to differing surface heat absorbing characteristics. The warmed air over land rises and the sea air moves in to replace it, creating a **sea breeze**. Obviously, the prevailing wind flow with a present marine layer is from the ocean to the land, or "onshore flow." Onshore flow is determined and measured by pressure differences (gradients) between higher pressure over the ocean and lower pressure over the desert. If the gradient is steep, the onshore flow is strong, and vice versa. We often refer to the pressure gradient between Lindbergh Field (SAN) and the Imperial Airport in El Centro (IPL) as a local benchmark.

The depth of the marine layer varies with upper level high pressure and low pressure. High pressure tends to suppress, or squish the marine layer down near the surface and is called a shallow marine layer. Low pressure allows the marine layer to deepen. However, if the low pressure has enough cold air aloft, it can wipe out the inversion. This “busts up” the marine layer, the warm and cold air layers mix, and the low clouds will clear. When the inversion is very strong and relatively shallow, the coastal clouds can stick to the beaches all day.

The common cloudiness near the coast occurs mainly during the night and early morning, then evaporates during the day. The clouds normally clear during the morning as a progression from inland areas to the coast. As the sun begins to warm the land surface (even through the cloud layer), the cloud layer begins to evaporate from the ground upward until the clouds completely evaporate. At dusk, the sun has set and the evaporation slows, so the onshore flow can move the clouds over land without evaporating. Very little mixing takes place between the cool moist marine layer and the warm dry layer above it due to stability. Cold air is more dense than warm air and finds stability or equilibrium at lower levels. As an analogy, the cool marine air is like water in a bathtub, content to stay at the bottom and not mix with the air above it. The clouds will not rise over the mountains without evaporating. If you hike in the sunny local mountains early on a summer morning you can see an “undercast” sky condition, a solid cloud layer below.

A **coastal eddy** is a counter clockwise circulation of low level winds in the California Bight (the California Bight is comprised of the ocean waters fronted by the concave Southern California coastline). Because these coastal eddy circulations are often centered around Santa Catalina Island, it is often called a **Catalina Eddy**. It forms when the air flow aloft becomes cyclonic (counter-clockwise) and when strong northwest winds blow off Point Conception. Those winds continue blowing toward the southeast and naturally curve into the bight. Imagine a pinwheel in the vicinity of Catalina. The stronger winds over the outer waters would spin that pinwheel counter clockwise because the winds in the inner waters are weaker. Eddy formation is accompanied by a southerly shift in coastal winds, a rapid increase in the depth of the marine layer, a thickening of the stratus cloud layer, and often some drizzle. The marine layer can deepen to 6,000' and extend well inland along the slopes of Southern California’s larger mountains and even through the lower passes into the deserts near Hesperia and Palm Springs. These occasions are almost always accompanied by drizzle or even light rain. Because the cloud layer is thick and the circulation produces more clouds, it takes much longer to evaporate the cloud layer. Over land the cloudiness can persist into the afternoon or even all day near the coast. Coastal eddies occur predominantly during the “stratus season” - spring and summer. Hence, you hear about “May Gray” and “June Gloom”.

At times with a deep marine layer, probably at least 2000' deep, the atmosphere below the inversion can become unstable as the sun warms the land surface. The initial stratus clouds clear, but the warm and moist surface air rises to produce shallow convection and cloud development capped by the inversion. Meanwhile, at the beaches the sea breeze is drawing cool surface air onshore, which stabilizes the atmosphere. In these situations, the coast clears while clouds continuously redevelop inland. This is what we call “reverse clearing” because clearing occurs from the beaches toward inland areas, the reverse of the standard clearing pattern.

Dense Fog can form when the stratus cloud layer comes in contact with the ground, usually along the inland edge of the cloud deck. When the marine layer is deep, dense fog will develop in the mountains and foothills. Fog can also develop as air ascends a mountain slope and condenses. When the marine layer is shallow, the clouds will not penetrate very far inland, staying near the coast. In these cases lower elevations may get dense fog. This kind of fog is called **advection fog** because the fog advects, or moves horizontally from one location to another.

Radiation fog, also called ground fog, is not usually related to the marine layer. It can develop on clear, cold, and calm nights when the air near the surface is moist, such as after a rainstorm. The moist air has a high dew point temperature. As the ambient temperature falls in the evening, it will approach the dew point and fog can develop. This is more common in inland valleys because they are sheltered from the modifying effect of the mild ocean.

Santa Ana Winds and Hot Weather

Santa Ana winds are strong, dry offshore winds that blow from the east or northeast. These winds are strongest below passes and canyons of the coastal ranges of Southern California. The name is derived from the Santa Ana Canyon, which is susceptible to these winds.

The complex topography of Southern California combined with various atmospheric conditions create numerous scenarios that may cause widespread or isolated Santa Ana events. Santa Ana winds develop when a region of high pressure builds over the Great Basin (the plateau east of the Sierra Nevada and west of the Rocky Mountains including Nevada and western Utah). This pressure pattern often follows the passage of an upper low through the interior west. If the upper low moves into northern Mexico or Arizona, the upper level winds will be from northeast, and enhance the northeast surface flow. The cold air associated with the upper low forms a dry front coming from the northeast. Strong subsidence associated with the cold air following these fronts forces strong winds aloft downward to the surface. This creates a turbulent mountain wave that touches the surface on the lee side of the mountains. On rare occasions, there may be precipitation with the system and a “wet Santa Ana” results, but most of the time a Santa Ana event brings clear skies and warm weather. Clockwise circulation around this high pressure area and subsidence (sinking motion) forces air down the mountain slopes from the higher plateau. The air warms and dries out, due to heating by compression, and accelerates as it descends toward the coast. Sometimes the winds are very localized, narrow corridors or rivers of wind, and nearby areas escape them.

Santa Ana winds occur mainly during Fall and Winter and are most common during December. Summer events are rare. A reasonably strong event can produce sustained wind speeds of 30 to 40 mph with gusts over 60 mph. During exceptional events the top gusts can exceed 100 mph. The strongest winds usually occur during the night and morning due to the absence of a competing sea breeze.

The impacts of these winds are numerous. There is always a high fire danger during these events. Trees and power lines are toppled, leading to property damage and power outages. High profile vehicles are at risk of being blown over. Turbulence and low level wind shear adversely affect aircraft, while strong winds can present great danger to boaters.

Fall events can bring hot weather as well as strong winds. Most high temperature records in coastal California have occurred during a hot Santa Ana. Legend and lore have sprung from these uncomfortable conditions. Early Mexican residents called them “los vientos del diablo” - the devil winds. It is a strange time for residents near the coast because their mild climate turns into the Sahara for a time. Fires increase, crime seems to go up, and numerous health conditions worsen, such as allergies. Some claim earthquakes are more likely during this “earthquake weather.” Like the time during a full moon, it just seems that more weird things happen.

Hot weather is relative in our region of wide variations. In the lower deserts it is a staple of life. Near the coast it is a rather rare occurrence. **Extreme heat** most often comes when strong high pressure aloft is present over the region. This produces an atmosphere that is generally subsiding, or sinking. As the air subsides, it compresses and warms as the pressure increases near the surface. When the monsoon flow over the desert southwest sends moisture into our region, this added humidity compounds the danger of the heat. Years ago, the National Weather Service developed the Heat Index to properly account for the body’s reaction to heat and humidity. See appendix F for the Heat Index Table.

Dust devils are products of a heated land surface and do not need extreme heat to develop. On sunny days, the ground heats up in a non-uniform way producing rising pockets of air called thermals. In strong thermals, the rising air develops a spin and the result is a dust devil, a narrow rotating column of air that can sometimes reach several hundred feet into the sky. Dust devils are usually not dangerous, but some can cause minor property damage. They are not associated with tornadoes, since tornadoes develop from strong thunderstorms. They are most common in the inland valleys and deserts of our region.

Tropical Connections: Hurricanes and Their Remnants

Hurricanes need warm ocean waters to survive and grow; as a general rule, the sea surface temperature should be above 80 degrees. Below that temperature, the hurricane will lose its energy and die. The California Current is a cool ocean current that parallels the California coast, maintaining the sea surface temperatures safely below 80 degrees. This is why hurricanes never strike the California coast, but the remnants of tropical cyclones can make a big impact in our region. If the conditions are right, these distant hurricanes can also send large ocean swell to Southern California beaches.

The eastern Pacific hurricane season runs generally from June through October. Hurricanes or tropical storms moving into the cooler waters will decay, but on occasion are strong enough to come very close to California at tropical storm strength and produce a wild, off-season rainfall event with widespread flash flood damage. Some of Southern California's heaviest rainfall events have been the result.

More likely, only the remnants of these storms will provide a source of warm, moist and unstable air off the coast of Mexico. If the upper level flow is from the south, this unstable air is brought into the region. There is very little rising motion associated with these moist air masses, but the high amount of moisture is sufficient to produce showers. Some local effects can enhance the precipitation. The ocean waters are warmest during late summer, so the stabilizing effect of the normally cool ocean waters is reduced. As these unstable tropical remnants move into Southern California, the orographic (mountain) effect and surface heating provide additional uplift necessary to produce the showers and thunderstorms.

El Niño and La Niña

The term El Niño (Spanish for the "Christ child") was originally used by fishermen along the coasts of Ecuador and Peru to refer to a warm ocean current that typically appears around the Christmas season. The term El Niño has come to be used for these exceptionally strong warm intervals that not only disrupt the fishing industry but also bring heavy rains to the normally dry region. La Niña (El Niño's sister) is the opposite of El Niño, where equatorial Pacific ocean waters are cooler than normal.

Normally in the tropical Pacific Ocean, the trade winds are persistent winds that blow westward from a region of higher pressure over the eastern Pacific toward a region of lower pressure centered over Indonesia. During El Niño years, this atmospheric pressure pattern breaks down. Air pressure rises over the western Pacific and lowers over the eastern Pacific. This change weakens or even reverses the trade winds. This fluctuation in pressure across the Pacific Ocean is called the Southern Oscillation. The normally strong coastal upwelling of ocean waters along the west coast of South America is decreased or stopped by the weakened trade winds and this allows warmer surface waters from the western Pacific to surge eastward toward South America. Because these pressure reversals and ocean warming are concurrent, it is referred to as the El Niño - Southern Oscillation, or ENSO.

The oceans and the atmosphere greatly influence each other. During normal years, the eastern Pacific waters cool the air above. Cool dense air does not easily form clouds and rain, especially in a warm tropical environment, so the coasts of Peru and northern Chile receive very little rain. When the ocean warms, the moist warm air above it becomes buoyant enough to produce rain. This shift in major rain zones has a ripple effect on wind patterns and climatic conditions all over the globe.

The impacts of El Niño and La Niña show up most clearly during the northern winter. El Niño winters are milder over Canada and the northern United States, while cooler and wetter than normal winters are experienced in the southern U.S. During La Niña years, winters are warmer in the upper Midwest and cooler in the Southeast and Southwest. It is wetter than normal in the Northwest and drier than normal in the southern third of the U.S. For more information about El Niño and La Niña, click on:

www.cpc.noaa.gov/products/analysis_monitoring/lanina or **meteora.ucsd.edu/~pierce/elnino/elnino.html**.

Global Warming, the Greenhouse Effect, and Climate Change

In recent decades it has been observed that the average temperature of the earth is rising. The numerous effects of this rise in temperature can greatly impact global climates and human life. This has produced cause for concern well beyond the scientific community. At the NWS in San Diego, no direct research or study of global warming is performed. For more information on the subject, click on: **ww2.wrh.noaa.gov/climate_info/Global_Warming.htm** and **www.epa.gov/globalwarming**.

Sun, Earth, Sea, Space, and Optical Phenomena

The sun, earth, sea and sky produce naturally occurring phenomena that generate questions directed to the NWS for explanation. These may include solar and lunar phenomena, optics, astronomy, space weather such as aurora borealis or solar flares, ocean behaviors beyond sea state, seismology, volcanology, and geology.

These phenomena do not fall under the expertise of meteorologists at the NWS. Meteorologists may have some knowledge about these phenomena and may offer it, but the knowledge or opinion is not qualified professionally, only possibly from a personal interest or hobby.

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A History of Significant Local Weather Events

The following events occurred in or near the forecast area of the NWS - San Diego, which comprises Orange and San Diego Counties, southwestern San Bernardino County, and western Riverside County. These events were chosen based on infrequency, severity and impact. Note: This listing is not comprehensive.

Heavy Rain: Flooding and Flash Flooding

Date(s)	Weather	Adverse Impacts
8.12.1891	16.10" at Campo; 11.50" in 80 minutes, a record 80 minute rainfall for the state.	
1.16-17.1916	Widespread heavy rains in Southern California. 16.71" in 24 hours at Squirrel Inn (near Lake Arrowhead), a record 24 hour rainfall for California.	Widespread flooding. At least 22 dead. Roofs in Chula Vista, poultry farm in Vista, boats in Coronado and Newport damaged. Most cities completely inundated. Pine trees from Palomar Mountain floating down San Luis Rey River through Oceanside.
4.5.1926	3.23" at San Diego, the wettest calendar day on record.	

1.1.1934	6.21" at Fullerton, 6.90" Placentia, 5.16" Yorba Linda, 4.69" Buena Park, 5.04" Anaheim, 5.38" Orange , 4.81" Garden Grove, 3.24" Newport Beach, 2.96" Laguna Beach, 3.55" San Juan Cap., 3" San Clemente, 2.65" Redlands, 2.68" Oceanside, 1.56" Carlsbad, 2.44" Escondido, 0.67" San Diego , 0.48" Victorville. Storm totals in southern slopes of mountains topped 12"(heaviest: 15.86" in Duarte).	36 die all over Southern California in floods.
2.28-3.3.1938	11.06" at LA.	79 killed in flooding. Santa Ana River floods. Whitewater River floods, isolates Palm Springs. Widespread property damage.
9.24-25.1939	“El Cordonazo” or “The Lash of St. Francis” a tropical storm that actually reaches Southern California and causes the greatest September rainfall ever. LA 5.42" in 24 hours, Mt. Wilson 11.60".	45 killed in floods all over Southern California.
12.23-24 .1940	3.62" at San Diego, the greatest 24 hour rainfall on record.	
1.23.1943	4.56" at Palm Springs.	
2.6.1950	Heavy rain.	Chino Creek inundates Hwy 71 from Corona to Ontario.
1.18.1952	3.98" in LA, 3.17" in 24 hours.	At least 8 dead in flooding.
7.25.1956	Thunderstorms: 1.26" Riverside, 1.05" Yucaipa, 1.01" Lytle Creek, 1.15" Upland. Almost 0.5" in five minutes at Glendora.	Flash flooding in San Bernardino, Riverside and Ontario.
1.4-5.1959	Big winter storm.	Roof damage and animals killed at San Diego. Considerable property damage from flooding and mud slides.
2.14-16.1959	Heavy rain.	Flooding in San Diego.
4.27-28.1960	Heavy rain.	1 drowning death and 3 traffic deaths. Flooding and closed highways.

11.5.1960	Heavy rain, mainly from Orange County northward.	1 drowning death, 2 injuries. Flooding, mud slides, and property damage. Power outages.
2.7-26.1962	A very wet period for Southern California. 20"+ in wettest mountain locations.	20 killed, 15 injured in flooding, mud slides. Property damage, trees down, boats damaged.
2.9-11.1963	Heavy rain.	Flooded highways and homes.
9.17-19.1963	6.50" in the mountains from tropical storm Katherine.	
11.19-20.1963	Heavy rain.	6 injured in local flooding and numerous traffic accidents.
12.1964		40 dead from flooding in LA and Orange Counties.
11.23.1965	9.59" at Cuyamaca.	
12.2-3.1966	Heavy rain in coastal areas.	Local flooding. Damage to buildings and highways.
12.5-6.1966	6.66" at Idyllwild on 12.5, 9.42" at Big Bear Lake on 12.6.	Flooding. Highway damage.
8.31.1967	2"+ comes from tropical storm Katrina.	
11.18-21.1967	14"+ in mountains above LA, 7.96" in LA. Called "worst since 1934."	2 killed. Flash flooding and mud slides. 400 stranded in mountains due to closed highways.
12.12-15.1967	Heavy rain.	2 drowning deaths in San Diego County.
3.6-8.1968	Heavy rain.	1 drowning death. Local flooding. Damage to buildings, homes, and schools. Landslides closed several highways.
1.18-28.1969	Heavy rain.	45dead from flooding and mud slides all over California. Scores dead in traffic accidents. Hundreds of homes and buildings destroyed in slides. Highways and railroads washed out. Power outages.

2.20-25.1969	Heavy rain.	21dead from flooding and mud slides all over California. Extensive damage to crops, farmland and livestock.
1.16-18.1973	Local amounts up to 3" on 1.16 and an additional 3" on 1.18.	Local flooding, mud slides, power outages.
2.10-11.1973	1-2" at coast, 3-7" coastal valleys, up to 12" at Mts. Wilson and Baldy. 6" in 6 hours at Mt. Wilson on 2.11.	Flooding and mud slides closed many roads.
1.3-5.1974	Heavy rain.	1 drowning death near Temecula. Many highways closed due to flooding and mud slides.
12.3-4.1974	Heavy rain.	Considerable flooding of low lying areas of Orange County.
2.4-10.1976	Heavy rain period. 4.30" at San Diego.	
9.9-12.1976	Record rains, flooding from tropical storm Kathleen. 14.76" at San Gorgonio, 8" Mt. San Jacinto, 10.13" Mt. Laguna.	6 buried and killed in sand in Ocotillo.
8.15-17.1977	Tropical storm Doreen brings heavy rain to San Diego County and desert areas. 4" Mt. Laguna, 2"+ Palm Springs, 4.5" Salton Sea in several hours.	Flooded roads in desert areas. Floods and crop damage at the Salton Sea.
12.27.1977	Heavy rain.	Mud slide in mountains northeast of Redlands buries a car killing 1 and injuring 3.
2.8-10.1978	Heavy rain: 16.4" at Lytle Creek, 13.64" Lake Arrowhead, 11.97" Wrightwood, 11.15" Devore, 10.4" Santiago Pk., 8.5" Crestline, 5" Ontario, 4.79" Big Bear Lake, 3.83" Santa Ana.	20 killed all over Southern California. Widespread flooding, flash flooding, and mud slides. Numerous homes washed away.
3.4-5.1978	Heavy rain.	20 deaths from flooding in LA area. 3 drowning deaths and disastrous flooding in Lakeside. 26 dead and 600 left homeless in Tijuana and Ensenada.

1.30-31.1979	2-4" rainfall in 24 hours over much of coastal Southern California.	
2.13-21.1980	Six storms hit Southern California. 12.75" in LA.	30 killed in widespread floods and mud slides. Roads and hundreds of homes destroyed or damaged. Mission Valley completely inundated between Friars Rd. and I-8.
3.1-3.1981	3" along coast and 5-6" in local mountains.	Widespread street flooding and mud slides. Power outages.
11.27-28.1981	Nearly 2" in LA area.	Highway deaths.
3.16-18.1982	2-4" in San Diego County.	Local flooding closed many streets.
12.8-9.1982	Heavy rain in eastern San Diego County.	Flooding; disastrous flooding in Ocotillo.
2.24-28.1983	Heavy rain.	Extensive street flooding. Damage to 30 cars and an apartment building in Anaheim.
4.17-20.1983	Heavy rain.	Street flooding and mud slides.
2.18-19.1984	Heavy rain.	Mud slides in Orange County up to 2' deep.
2.14-17.1986	Heavy rain.	1 death from flash flooding.
3.15-16.1986	Heavy rain in Orange County.	Mud slides along the coast.
1.4.1987	Heavy rain: 1-2"+ in the northern Inland Empire.	Lots of street flooding. Road washouts in the high desert.
10.22.1987	Heavy rain in northern San Diego County.	Flash flooding and debris/mud flows in Pauma Valley (exacerbated by a previous fire on southwest slopes of Palomar Mountain.). A building destroyed, 4 homes evacuated.
10.5-12.1987	Heavy rain from Hurricane Ramon: 0.75" at coast, 2" in mountains, 2.14" at Camp Pendleton, 0.69" at Lindbergh Field.	Minor flood damage.
11.4-5.1987	Heavy rain and thunderstorms.	Flooded roadways and intersections.

2.2.1988	Subtropical system drops 4" in the mountains of San Diego County.	Standing water 5' deep in some intersections. Some homes flooded with 3-6' of water.
4.19-23.1988	Heavy rain.	Flooding, mud slides, and numerous traffic accidents.
2.4.1990	Heavy rain in the San Bernardino area.	1 death from flooding.
6.9-10.1990	Rain and thunderstorms from Hurricane Boris. 0.37" at San Diego in 30 minutes, 1.41" Mt. Laguna, 0.98" Escondido, 0.87" Fallbrook.	
2.27-3.1.1991	Series of storms produced 3-6" at lower elevations, 11-14" in the mountains. 9.58" at Palomar Mountain.	2 dead, 6 injured. Urban flooding, mud slides, and road washouts. Flood waters 5' deep at Desert Hot Springs.
3.17-20.1991	A vigorous storm produced 1-8" in lower elevations, up to 14" in the mountains.	Local flooding and mud slides.
12.27-29.1991	Back to back storms dropped 2-7" at lower elevations.	Flooding of low lying areas, mud slides, and closed highways.
1.5-7.1992	1-2" at lower elevations.	Flooding and mud slides.
2.5-16.1992	A series of many intense storms brought heavy rain. A total of 20"+ in the mountains and 8-16"+ at lower elevations.	2 killed in avalanche at Mt. Baldy. Flash flooding, mud slides, and road closures.
3.1-7.1992	A series of storms brings 1-4".	Local flooding.
3.20-23.1992	A series of storms brings 1-5".	Local flooding.
4.1.1992	Heavy rain from thunderstorms. 3" in less than 1 hour at Escondido.	Flash flooding.
12.4-7.1992	Big storm produces 0.5-6" from the coast to the mountains.	Local flooding. Mud slides, standing water, and road closures.
1.6-18.1993	A very wet series of storms produces 20-50" of precipitation in the mountains and up to 12" at lower elevations over a two week period. One of the longest periods of consecutive days of rain on record (13).	Flooding and flash flooding, mud slides, etc.

2.18-20.1993	Heavy rain: 1-2" at Carlsbad.	Flooding from Oceanside to Encinitas. Homes damaged along Mojave River in Hesperia.
8.25-26.1993	Rain and thunderstorms from Hurricane Hilary. 3-4" in two hours from heavy thunderstorms in the San Bernardino Mountains, Morongo Valley, and Desert Hot Springs.	Flash flooding in Yucaipa and Morongo Valley.
2.7-10.1993	1-5" near the coast, up to 10" in the mountains, 0.5-1.5" in the deserts.	Widespread flooding.
3.25-26.1993	Heavy rain.	Local flooding, mud, debris, and road closures in Orange County.
1.3-4.1995	Heavy rain.	Flash flooding in Seal Beach, Norco, and Oceanside.
1.10-11.1995	Heavy rain.	Extensive flooding in Orange County.
1.14.1995	8-9" in northern Inland Empire.	Extensive flooding in Yucaipa. Many roads closed.
3.5-6.1995	6" in 24 hours, 10.34" in 48 hours at Idyllwild. 8.57" in 24 hours and 14.58" in 48 hours at Palomar Mountain.	
3.11.1995	3.07" at Banning - Beaumont, 2.75" at Murrieta, 2.10" at Moreno Valley, 1.23" at Riverside, 0.84" at Palm Springs, 7.73" at Wrightwood in 48 hours.	Section of I-5 washed out, lots of local flooding.
2.25-28.1996	0.5-1.5" in coastal areas.	
12.21-22.1996	2" in coastal areas, 2-5" in inland valleys and foothills.	
1.12-13.1997	1-3" in coastal areas and valleys.	
2.23-24.1997	Heavy rain.	Widespread flooding in coastal cities and Inland Empire. Homes stranded in De Luz. Cliff erosion in Del Mar and Solana Beach.
9.2.1997	Thunderstorm at Pine Cove drops 3.7" in one hour.	

9.4.1997	Heavy rain from Hurricane Linda: 2.5" per hour rain rates at Forest Falls. (Hurricane Linda was the most powerful eastern Pacific hurricane on record, with gusts to 218 mph).	Disastrous flooding and debris flows at Forest Falls: $3.2 million damage, 2 houses destroyed, 77 damaged, car-size boulders, wall of mud 150' wide and 15' tall. Flooding damage also at Oak Glen.
9.24-26.1997	Heavy rain and thunderstorms from Hurricane Nora. 5.50" at Mt. San Jacinto, 4.70" Mt. Laguna, 4.41" Mt. San Gorgonio, 3-4" at several locations in mountains, 3.07" Twentynine Palms, 1.5-2" at Coachella and Borrego Valleys, 2.88" Hemet, 1-2" in many inland areas.	Flooding in Palm Springs, Borrego Springs and Spring Valley. Traffic deaths.
10.7.1997	Heavy rain in Inland Empire. Storm was of 100 year intensity. 1.65" in 1 hour and 15 minutes, 0.31" in 3 minutes at Hemet.	Floods and debris flows. $2.5 million damage. Large trees, mud and boulders swept down canyons. Homes, apartments flooded at north San Bernardino and Highland.
12.6-8.1997	Heavy rains of 4-8" across Orange County, heaviest in 70 years. 10" at Mission Viejo, over 4" Corona. Heavy downpours in Victor Valley.	Widespread flooding in Orange County. Mud slides and coastal erosion. Flooding in Corona and several communities of Victor Valley. Mud flow through Adelanto.
1.8-10.1998	Heavy rain of 2".	Floods and mud in Del Dios.
2.3-4.1998	Heavy rain of 3".	Flooding, mud slides, power outages.
2.6-9.1998	Heavy rain. Up to 3" rainfall over all of Southern California.	Catastrophic and widespread flooding, especially in Newport Beach and Irvine. Lots of property damage in southern Orange County. Evacuations and swift water rescues. Landslides, mud slides, and sink holes. Roads, bridges, and railroads damaged.
2.14-15.1998	1-2" in coastal areas, 3-5" in valleys and foothills.	Flooding and mud slides.

2.23-24.1998	Heavy rain. 2-5" rainfall over all of Southern California.	2 dead, 2 injured. $100 million estimated damage. Power outages. Catastrophic and widespread flooding. Hundreds of homes damaged. Numerous evacuations and swift water rescues. Landslides, mud slides, and sink holes. Roads, bridges, and railroads damaged. Livestock and crop loss.
3.25.1998	3.5" in 4 hours at San Clemente.	Flooding.
5.12.1998	Rain in San Diego.	First rain-out of a San Diego Padres game in Mission Valley in over 15 years.
7.20.1998	Heavy thunderstorms.	Flooding at Mission Beach and Barton Flats in San Bernardino Mountains.
8.12-14.1998	Strong thunderstorms in Apple Valley.	Flash flooding.
8.29-31.1998	Strong thunderstorms. 0.77" in 45 minutes at Wrightwood, 1.5" at Apple Valley, 0.68" in 30 minutes at Forest Falls.	Flash flooding in Hemet. Homes and roads flooded with 4 to 6" of water in Hesperia and Apple Valley. Rock slides in Mill Creek. Flooding of roads in Sugarloaf and Forest Falls.
7.8.1999	Heavy thunderstorm s.	Flooding in San Jacinto, Palm Springs, Cathedral City, and Palm Desert.
7.11-13.1999	Heavy thunderstorms in and around the higher mountains. 1.65" in less than 30 minutes at Lake Henshaw, 1.57" in 20 minutes at Big Bear City, 1.40" in 30 minutes at Sugarloaf, 1.6" in 85 minutes at Forest Falls, 1" in 1 hour at Pine Cove, 1" in 25 minutes at Shelter Valley. 1" per hour rain rate at Phelan. 1.8" in 25 minutes at Forest Falls again on 7.13.	2 dead, dozens injured, 6 homes destroyed, many more damaged, 20' high wall of water moving at 45 mph moving 70-ton boulders at Forest Falls. Buildings washed away at Jenks Lake. Disastrous flooding and mud slides at Oak Glen, Big Bear City, and Apple Valley. Flooding in Yucca Valley area, Beaumont area and Palm Springs. Roadways closed due to flash flooding.
7.21.1999	Heavy thunderstorms near Borrego Springs.	Flash flooding damage at Borrego Springs and Ocotillo Wells.

2.10.2000	Heavy rain.	3 killed, 8 injured from flooding and mud slides.
2.21-23.2000	Heavy rain.	Lots of flooding, mud slides. Roads washed out in Hemet.
4.17-18.2000	Up to 2" at lower elevations.	
8.24.2000	Thunderstorm drops 0.76" at Palomar Mountain.	Mudslide closes Highway 76.
8.29.2000	Desert thunderstorms: 1.5" in 45 minutes at Borrego Springs.	Flash flooding, mud in homes, roads damaged in Borrego Springs area. Flash floods, mud, and debris covered roads from Yucca Valley to Palm Springs.
9.7.2000	Heavy thunderstorm in Morongo Valley.	Flash flooding.
1.10-11.2001	Heavy winter storm. 1.74" at Phelan.	Flash flooding in Huntington Beach and Garden Grove.
2.11-13.2001	Heavy winter storm. 2-5" at Orange County and the western Inland Empire. 1-2" over the rest of the lowlands.	Extensive urban flooding and mud slides. Trees and power lines knocked down.
7.7.2001	Strong thunderstorms in Victor and Lucerne Valleys. 0.25" in five minutes at Lucerne Valley.	Roads closed due to flash flooding, mud slides.
9.2-3.2001	Thunderstorms from Hurricane Flossie. 2.1" in 1 hour at Lake Cuyamaca.	Flash floods and mud slides in the San Bernardino Mountains and Lake Cuyamaca.
9.30-10.1.2001	Thunderstorms in mountains and inland valleys.	Flooding in Beaumont.
2.11-14.2003	Heavy rain: 10.15" at Forest Falls, 9.75" Lytle Creek, 8.47" Lake Arrowhead, 7.60" Santiago Peak, 6.86" Mira Loma, 5.15" Wrightwood, 3.95" Hesperia, 3.87" Lake Elsinore, 3" Lindbergh Field.	Localized flooding.

Heavy Snow, Rare Snow at Low Elevations

Date(s)	**Weather**	**Adverse Impacts**

12.1847	Light snow in hills above Old Town San Diego. Greater amounts to the east.	
1.12-14.1882	15" at San Bernardino. 3' in Campo over four days. 2-5" in outlying San Diego, including: 4" along Poway Grade, 3" at El Cajon, 1" Poway. Light snow in Del Mar. Snow flakes, but not sticking at San Diego.	Birds and livestock killed, telegraph lines down.
1.11.1930	2" at Palm Springs.	
1.21.1937	Snow flurries at San Diego. Trace amounts stuck to northern and eastern parts of the city.	
2.11.1946	Snow flurries in many parts of San Diego.	
1.9-11.1949	Snow in lowlands: 14" Woodland Hills, 8" La Canada and Catalina Island (2,100'), 6" Altadena, 5" Burbank, 4" Pasadena, 1" Laguna Beach and Long Beach.. A trace in San Diego, the only time since 1882. 3' Mt. Laguna, 18" Cuyamaca, 1' Julian, 4-8" as low as 1000' elevation. A light covering in La Jolla, Point Loma, Miramar, Escondido, Spring Valley, and other outlying San Diego areas.	Snarled all kinds of transportation. Power outages and emergencies. Plane crash kills 5 and injures 1 near Julian. Camping group stranded at Cuyamaca.
1.20-21.1962	Snow to lower elevations.	Highways closed.
12.9.1963	Heavy snow in the mountains.	5 killed, 6 injured. Highways blocked.
3.12-13.1967	Heavy snow in the mountains.	Highways closed.
12.13-19.1967	50" at Mt. Laguna, 38" Idyllwild, 2' Palomar Mountain, 12-18" in higher elevations. 6" Temecula, 5" Fallbrook, 4.5" Anza Borrego State Park, 3" Borrego Springs, 2" Carlsbad on 12.13. Light covering over many San Diego mesas.	1 freezing death. Numerous schools and highways closed. Transportation disrupted. Power outages.
2.20-25.1969	Heavy snow in mountains approach greatest depths on record.	

1.3-5.1974	Over 18" in San Bernardino Mountains.	Structures and a few roofs collapse due to weight of snow. Power lines and trees snapped.
11.28-29.1975	First winter storm of season was heavy. Up to 2' in San Bernardino Mountains, 16" at Big Bear Lake.	20 stranded campers rescued after a few days.
3.2-4.1976	20" at Running Springs.	
1.30-31.1979	2" at Palm Springs. Widespread snow.	
11.27-28.1981	3' at Big Bear Lake.	
3.18.1982	25" at Palomar Mountain.	
2.18-19.1984	Up to 16" in the mountains.	
3.15-16.1986	3' in the San Bernardino Mountains.	
1.4.1987	Up to 15" in the San Bernardino Mountains.	
2.22-24.1987	22" at Cuyamaca, 12-17" in the San Bernardino Mountains, 6" Pine Valley, 3" Lake Morena. Snow pellets to coastal areas: 2-3" at Huntington Beach, measurable at San Diego Bay front.	Schools closed in mountain areas.
12.24.1987	Snow flurries within San Diego city limits. Not a flake officially at San Diego. Heavy snow in the Laguna Mountains.	
2.7.1989	Snow at the beaches in LA to the desert in Palm Springs. 15" in the mountains.	Major road closures. Numerous traffic accidents.
1.16-17.1990	Snow flurries within San Diego city limits. None officially at San Diego. 14" at Mt. Laguna. 10-16" in mountains.	
2.4.1990	10-13" in the mountains.	
2.16-18.1990	3-4' in the mountains.	Avalanche at Wrightwood buries 10 hikers, injuring 1.
2.27-3.1.1991	Back to back storms dump 2-3' in the Big Bear area, up to 2' elsewhere in the mountains.	Highways closed.
3.17-20.1991	2-5' in the mountains.	

3.27.1991	36" at Lake Arrowhead, 27" Big Bear Lake, and 18.5" Idyllwild.	
1.5-7.1992	6-20" in the mountains, 2-8" in foothills and high desert floors.	
12.4-7.1992	6" to 2' in the mountains.	
2.7-10.1993	8-18" in the mountains.	
1.3-4.1995	6-12" in the mountains. Snow in the high desert: 2" of heavy, wet snow at 2300'.	
3.11.1995	Over 20" at Bear Mountain.	
12.23.1995	12" in the San Bernardino Mountains, 8" on the high desert floors.	
1.22-23.1996	12" above 4000'.	
2.25-28.1996	10" at Idyllwild, 2" Yucaipa, a dusting at Hemet and Corona. 1-2' in mountains, up to 6" in high desert.	
3.12-13.1996	8-12" in the San Bernardino Mountains.	
1.12-15.1997	18" at Mt. Laguna. 18"-3' snow above 2500'. Ski resort at Snow Valley open until 5.18, the latest in 78 year history.	13 illegal immigrants die near Pine Valley.
2.23-24.1998	1-2' above 6000', 3-4' above 7000'.	Trees and power lines down.
3.28-29.1998	Coldest storm of the year. 1-3' above 5000', 4-8" above 3000'. Ice pellets and hail 1" deep in some coastal and foothill areas.	Considerable damage to crops. Serious traffic accidents.
4.1.1998	Up to 3' of powder at ski resorts. 18" at Pine Cove.	
1.26.1999	22" over a large area around Running Springs, 18" at Angelus Oaks.	Road closures.
4.1-2.1999	7-9" at Pine Valley and Descanso, 2" at Boulevard, “heavy snow” reported at Cherry Valley (3000'), 1" at Homeland (1,700').	7 illegal immigrants found dead near Descanso, 2 just over the border.

6.2-3.1999	Latest measurable snow on record for area mountains. 3" at Mt. Laguna, 1" Wrightwood.	
2.21-23.2000	18" at Forest Falls.	
3.4-6.2000	Up to 17" in 24 hours in the mountains. 14" at Forest Falls.	3 illegal immigrants dead south of Mt. Laguna.
4.17-18.2000	Late winter storm: 18" at Wrightwood.	
1.10-11.2001	13-18" in Idyllwild area. 3" in Phelan.	
2.6-14.2001	Over a week of heavy snow called “most in a decade”: 5' at Blue Jay and Mountain High, 2' Snow Summit, 5-12" at Apple Valley. Mountain High reports 12" on 2.6, 10" on 2.11, 36" on 2.12, 30" on 2.13, 8" on 2.14.	Roof of ice rink caves in at Blue Jay.
2.28.2001	32" at Mountain High.	
1.28-29.2002	Light snow in southern Inland Empire.	
3.18.2002	3" in Apple Valley, the greatest daily snow amount for March. 1" in Hesperia.	

Severe Thunderstorms: Large Hail, Strong Thunderstorm Winds, and Killer Lightning
(See flash flooding in heavy rain section)

Date(s)	Weather	Adverse Impacts
2.28-3.3.1938	Thunderstorms.	1 killed by lightning in Corona.
9.2.1960	Golf ball size and baseball size hail at Boulevard area. 2-3" precipitation. Hail diameter measured at 2.75" and weighed over 1 lb., some stones estimated larger. 2.75" hail also in Riverside County.	Considerable damage to houses.
1.30-31.1979	Golf ball size hail.	
9.21.1987	Frequent lightning and thunderstorms from Hurricane Norma.	Numerous power outages and small fires ignited.
4.26.1994	Large hail up to 0.75" from San Dimas to Ontario.	Section of I-215 closed.

1.12-13.1997	Dime size hail up to 1' deep over a small area in Buena Park and Cypress.	
2.17.1997	Marble size hail at Yucaipa.	
5.18.1997	Wet microburst in Apple Valley (in addition to two tornadoes).	Building and structure damage. Power lines arcing down and producing fires.
8.3.1997	Dime size hail at Campo.	
9.1-2.1997	Strong thunderstorm winds: three gusts to 104 mph at Twentynine Palms. Apple Valley gust 62 mph.	Large tree blown down in Apple Valley.
9.4.1997	Thunderstorms from Hurricane Linda: golf ball size hail in Forest Falls area.	
3.28.1998	Microburst in Lake Elsinore.	Tree uprooted, extensive roof damage.
4.1.1998	Grape size hail piled up 2" deep at Laguna Niguel.	
8.12-14.1998	Downburst in Hemet with winds 70 mph and 0.75" hail. Strong winds in Apple Valley. Golf ball size hail at Cajon Pass. 1.6" rain in 30 minutes at Boulevard.	Buildings damaged, trees and power lines down in Hemet.
8.29-31.1998	Severe thunderstorms. Wind gust of 86 mph at Sage (south of Hemet), gust 50 Rialto, 45 San Marcos.	Downed trees and power lines.
9.2.1998	Severe thunderstorms at Hemet and San Marcos from Hurricane Isis. Strong winds from thunderstorms in Orange County with gusts to 40 mph.	Large fires in Orange County.
12.6.1998	Thunderstorm in Los Alamitos and Garden Grove: gusts 50-60 mph called "almost a tornado."	
7.13.1999	0.75" hail at Forest Falls.	
3.5-6.2000	Golf ball size hail at Garden Grove, Santa Ana, and Running Springs. Strong thunderstorm winds at the coast: gust 60 mph at Huntington Beach.	Property damage and trees downed along the coast from Huntington Beach to Sunset Cliffs.
8.1.2000	0.5" hail at Lake Arrowhead.	

8.29.2000	Thunderstorm wind gust to 61 mph at Borrego Springs.	
9.7.2000	“Big” hail strikes Forest Falls. Lightning strikes Oceanside High School.	
2.13.2001	Thunderstorm gust to 89 mph in east Orange.	
2.27.2001	Dime size hail in Mira Mesa, and 8" of graupel (soft hail) pile up on I-15.	Traffic delays.
8.8.2001	Strong thunderstorm in Twentynine Palms.	Damages.
9.2-3.2001	Strong thunderstorms from Hurricane Flossie.	1 boy killed by lightning in Apple Valley. 1 man killed and 1 boy injured by lightning at Cuyamaca Rancho State Park. Trees fell on a house in Beaumont.
9.30-10.1.2001	Thunderstorms in mountains and inland valleys.	1 killed by lightning at Cuyamaca Rancho State Park.

Tornadoes, Funnel Clouds, Waterspouts, and Damaging Dust Devils

Date(s)	**Weather**	**Adverse Impacts**
4.6.1926	Waterspout comes ashore in National City resulting in the most damaging tornado on record in San Diego County.	8 injured. Roofs torn off homes.
3.16.1952	Tornado in Santa Monica.	3 dead in storm; damage.
6.25.1954	Tornado northeast of Victorville.	
4.6.1955	Tornado north of Moreno Valley.	
4.13.1956	Tornado in Chula Vista.	1 injured. Property Damage.
4.1.1958	Tornado in Laguna Beach.	
10.8.1961	Tornado in Carlsbad.	Property Damage.
2.19.1962	Tornado in Irvine.	
4.8.1965	Tornado in Costa Mesa.	

11.7.1966	Tornadoes in Newport Beach and Costa Mesa.	Property Damage.
7.22.1966	Tornado in Victorville.	
11.30.1970	A waterspout and three small funnel clouds reported six miles west of San Diego.	
2.23.1971	A tornado 10 miles east of Brown Field, Otay Mesa, near Mt. San Miguel. Numerous funnel clouds in Chula Vista, Brown Field, and San Ysidro. A waterspout off Imperial Beach.	
2.23.1973	Tornado near San Diego.	
7.20.1974	Tornado in Hemet.	Property damage.
10.22.1974	Tornado in Yucca Valley.	Property damage.
10.29.1974	Tornado in Encinitas.	
9.4-6.1976	Six tornadoes. 5 around El Mirage, west of Adelanto, one near Mt. Baldy.	Property damage.
3.16.1977	Tornado skipped from Fullerton to Brea..	4 injured. Damage to 80 homes.
2.9.1978	Tornado in Irvine.	6 injured; property damage.
12.17.1978	Tornado in Oceanside.	3 injured. Damage to vehicles and structures.
2.25.1987	Several funnel clouds and waterspouts around San Diego County.	Waterspouts damaged many boats in Coronado harbors. One 30' cabin cruiser flipped.
1.18.1979	Tornado in Tierrasanta - San Diego.	
1.31.1979	Tornado in Santa Ana, possibly elsewhere.	Numerous power outages.
2.20.1980	Tornado in Clairemont - San Diego.	Considerable property damage.
1.20.1982	Tornado in Riverside.	
3.17.1982	Tornado at Lindbergh Field - San Diego.	
9.7.1982	Tornado in Landers.	Property damage.

11.9.1982	Tornadoes in Garden Grove and Mission Viejo.	Property damage.
8.1.1983	Tornado in Landers.	Property damage.
1.13.1984	Tornado in Huntington Beach.	Property damage.
2.3-4.1985	Tornadoes in Tierrasanta and Allied Gardens - San Diego. Funnel clouds at Brown Field.	Eight mobile homes damaged. Other property damage.
9.18.1985	Tornado around the north shore of the Salton Sea.	
3.16.1986	Tornado in Anaheim.	Property damage.
2.22-24.1987	Tornadoes and waterspouts in the Huntington Beach area.	
7.27.1987	Tornado in Twentynine Palms.	
1.18.1988	Tornadoes in Mission Viejo and San Clemente.	Property damage.
1.14.1990	Tornado in East City Heights - San Diego.	Property damage.
2.28.1991	Tornado in Tustin.	
3.19-20.1991	Tornado in East City Heights - San Diego on 3.19. Tornadoes in Riverside and Muscoy (near San Bernardino) on 3.20.	Property damage in San Diego.
3.27.1991	Tornado in Huntington Beach and San Marcos.	
2.15.1992	Tornado in Camp Pendleton.	Property damage.
12.7.1992	Tornadoes in Anaheim, Westminster, and Carlsbad.	Property damage.
12.29.1992	Tornado in San Clemente.	Property damage.
1.18.1993	Tornado in Orange County. Funnel cloud in Hemet.	Property damage.
2.8.1993	Tornado in Brea.	Property damage.
3.26-28.1993	Funnel clouds near Temecula and a funnel cloud in Moreno Valley.	

11.11.1993	Tornado in Portola Hills (near Tustin).	2 injuries; property damage.
2.7.1994	Tornado from Newport Beach to Tustin.	Roof and window damage. Trees blown down.
4.26.1994	Waterspout 11 miles southwest of Camp Pendleton.	
8.12.1994	Tornado in Valle Vista (east of Hemet) and several funnel clouds in Hemet.	Trees uprooted. Power poles blown over. A home damaged and a trailer destroyed.
12.13.1994	Two waterspouts about 0.5 mile off Newport Beach.	
12.13.1995	Funnel cloud near Fullerton airport.	
3.13.1996	Funnel cloud in Irvine, two southwest of Moreno Valley, and one northwest of Hemet.	
5.25.1996	Funnel cloud 10 miles west of Lindbergh Field - San Diego.	
12.22.1996	Tornado in Cabazon.	Threw a 5 ton mobile home 30 feet. Minor damage to six other mobile homes.
1.12.1997	A waterspout 2 miles southwest of Lindbergh Field - San Diego came ashore at Shelter Island.	Damage to resort.
2.28.1997	Funnel cloud in Kearny Mesa - San Diego.	
4.2.1997	Funnel cloud 5 miles west of Lindbergh Field - San Diego.	
5.11.1997	Tornado in Apple Valley.	Catastrophic damage to buildings, structures, trees, power lines.
5.18.1997	Two tornadoes in Apple Valley and a wet microburst. Estimated 130-140 mph winds.	Building and structure damage. Power lines arcing down and producing fires.
5.20.1997	Tornado 7 miles east of Borrego Springs.	
6.6.1997	Tornado in Hesperia.	Destroyed a large fountain.

6.13.1997	Funnel cloud 2 miles northwest of Lindbergh Field - San Diego.	
8.6.1997	Funnel cloud in Pine Valley.	
11.10-11.1997	A waterspout came ashore at Newport Pier 11.10 and quickly dissipated over western Costa Mesa. Winds were estimated at 60 to 70 mph. Tornado in Irvine 11.11, and another funnel developed.	Minor power outages. Little damage. A fisherman was blown from one end of the Newport pier to another. Property and vehicle damage in Irvine from flying debris. Ten cars were thrown a few feet.
11.30.1997	Waterspout 6 miles south of Newport Beach.	
12.8.1997	Funnel cloud in Del Mar.	
12.21.1997	Waterspout and tornado in Huntington Beach.	Damage to boats, houses, and city property.
1.2.1998	Funnel cloud southwest of Chula Vista.	
1.9.1998	Waterspout 3 miles off Laguna Beach. Tornado at Long Beach	Property damage in Long Beach.
1.29.1998	Waterspout moves ashore on Moonlight Beach and becomes a tornado at Encinitas	Property damage.
2.9.1998	Tornado in Cardiff - Encinitas and Rancho Santa Fe.	Minor damage.
2.17.1998	Waterspout off Point Loma.	
2.24.1998	Tornado in Huntington Beach. Waterspout off Mission Beach.	Property damage, power outage. Roof travels 1/4 mile.
3.13-14.1998	Numerous waterspouts between Long Beach, Huntington Beach and Catalina. Funnel clouds in Phelan and Hesperia.	
3.28.1998	Funnel cloud in Dulzura.	
3.31-4.1.1998	Numerous funnel clouds reported near Orange and San Diego County coasts, two of which became waterspouts off Orange County. One waterspout briefly hit the coast south of the Huntington Beach Pier.	

5.5.1998	"Apparent" tornado in San Bernardino and Rialto	Shredded metal siding in Rialto.
5.6.1998	Waterspout 1 mile west of North Island.	
5.13.1998	Tornado in Homeland. Funnel clouds in Homeland and Moreno Valley.	Damage to mobile homes in Homeland.
6.6.1998	Two funnel clouds off Dana Point.	
9.27.1998	Funnel cloud over Mission Beach.	
12.5.1998	Funnel cloud 2 miles southwest of Imperial Beach.	
1.25.1999	Funnel cloud 1 mile off Costa Mesa coast.	
4.1-3.1999	Waterspout 6 miles off Newport Beach on 4.1. Funnel cloud 3 miles west of La Jolla on 4.2. Waterspout 3 miles southwest of Oceanside on 4.3.	
4.7.1999	Funnel cloud 2 miles west of La Jolla.	
4.12.1999	Funnel cloud northeast of Temecula.	
6.3-4.1999	Funnel cloud 1 mile off San Clemente. Waterspout off Laguna Beach.	
7.10.1999	Funnel cloud in Hesperia.	
7.12.1999	Tornado 6 miles east of Julian. Recorded wind speeds 43 mph.	Building and structure damage. Trees uprooted and knocked over.
7.21.1999	Tornado in Shelter Valley.	Property damage.
12.31.1999	Funnel clouds in Santa Ana and Oceanside. Waterspout off Costa Mesa coast.	
2.21.2000	Tornado at Anaheim Hills.	Property damage.
3.3.2000	Waterspout 3 miles west of La Jolla.	
3.7.2000	Waterspout 10 Miles West of San Clemente. Funnel cloud 2 miles west of La Jolla.	
6.14.2000	Funnel cloud in Phelan.	
6.23.2000	Two funnel clouds around Hesperia.	

6.25.2000	Funnel cloud 12 miles west of Ocean Beach.	
8.25.2000	Funnel cloud came within 200 feet of the ground in Jacumba.	
9.7.2000	Funnel cloud over Carlsbad.	
10.28.2000	Funnel clouds around Newport Beach and Costa Mesa.	
11.10.2000	Tornado in southeast Poway.	Damage to 8 houses, trees uprooted and knocked down, vehicles moved.
1.10-12.2001	Funnel cloud at Orange County Airport, Newport Beach on 1.10, and Kearny Mesa - San Diego on 1.11. Waterspout 3 miles west of Chula Vista on 1.11 and 12 miles west of Mission Beach on 1.12.	
2.10-11.2001	Waterspout 2 miles west of La Jolla and a funnel cloud 3 miles northwest of La Jolla on 2.10.Waterspout 3 miles off Laguna Beach and two waterspouts 1 mile west of Ocean Beach on 2.11.	
2.13-14.2001	Funnel clouds in Palm Desert on 2.13 and 9 miles west of Oceanside on 2.14.	
2.24.2001	Tornado in Orange.	Damage to a warehouse, 6 structures, fences, and telephone wires.
2.27.2001	Several funnel clouds in Escondido. A waterspout 10 miles west of San Diego - Lindbergh Field.	
3.6.2001	Funnel cloud in Yorba Linda.	
4.9.2001	Two funnel clouds 4 miles southwest of San Diego - Lindbergh Field.	
5.28.2001	Two brief waterspouts 5 miles west of Laguna Beach.	
7.3.2001	Dust devil in Hesperia (may be a microburst or other thunderstorm wind).	Blows off roof.
7.7.2001	Tornado at Twentynine Palms and Joshua Tree.	Minor damage to homes and businesses in Joshua Tree.

8.15.2001	Dust devil in Menifee.	Damage to shed.
8.17.2001	Funnel cloud in Dulzura.	
2.17.2002	Two funnel clouds around Carlsbad.	
3.24.2002	Two funnel clouds around Carlsbad.	
10.26.2002	Funnel cloud 5 miles northeast of Borrego Springs.	

Strong winds
(for thunderstorm related winds, see severe thunderstorms)

Date(s)	Weather	Adverse Impacts
9.24.1939	Tropical storm. 50 mph winds.	48 dead from sinking boats.
2.11.1946	Icy cold winds in mountains of San Diego County with gust 72 mph.	
1.10.1949	Cold winter storm. Gust to 75 mph in the mountains of San Diego County, gust to 40 mph in San Diego.	Plane crash kills 5 and injures 1 near Julian.
11.5-6.1961	Santa Ana winds.	Fire in Topanga Canyon.
9.26.1963	Santa Ana winds. Gusts over 50 mph in the mountains of San Diego County.	Hottest heat wave west of mountains in the county on record.
11.19-20.1963	Strong storm winds.	Hundreds of trees downed. Power lines downed.
12.2-3.1966	Strong storm winds.	Power outages.
1.18-28.1969	Strong storm winds.	4 dead from falling trees. Power outages.
2.20-25.1969	Strong storm winds.	Telephone, power, and gas outages.
9.26-29.1970	Gusts to 60 mph at Cuyamaca Rancho State Park.	The Laguna Fire. 8 killed, 400 homes destroyed, 185,000 acres burned as of 9.28 from Cuyamaca to Alpine.
2.10-11.1973	Strong storm winds. 57 mph at Riverside, 46 Newport Beach.	Some 200 trees uprooted in Pacific Beach alone.
2.4-10.1976	Strong storm winds: 64 mph at Palmdale.	

11.30-12.1.1982	Widespread strong wind with a big storm.	Power out to 1.6 million homes.
3.15.1987	Widespread strong storm winds.	Motor homes toppled in the desert, boats flipped over in harbors.
1.17.1988	Gust to 64 mph from the west at San Diego - Lindbergh Field, highest wind on record.	
10.26-27 .1993	Santa Ana winds: gust 62 mph at Ontario.	Fire in Laguna Hills.
12.24.1993	Santa Ana winds: gust 75 mph at Ontario.	
12.14.1996	Santa Ana winds: gust 111 mph at Fremont Canyon, gust 92 Rialto.	2 killed from flying debris.
12.21-22.1996	Storm winds 40-50 mph.	
1.5-6.1997	Storm winds: gust 99 mph at Fremont Canyon, 58 mph elsewhere.	
1.29.1997	Santa Ana winds: gust 100 mph at Fremont Canyon, 87 Rialto.	Big rigs blown over.
10.14.1997	Santa Ana winds: gusts 87 mph in central Orange County.	Large fire in Orange County.
12.10-12 .1997	Santa Ana winds: gust 96 mph at Pine Valley, 87 Upland.	2 killed from flying debris. Property damage in Sun City. Crop damage. Boats damaged and sunk at Coronado and Avalon.
12.18-22 .1997	Gusts 60 mph at Rialto. Gusts 67 mph at Idyllwild and below Cajon Pass.	1 killed. Fire, trees down, and widespread wind damage.
12.29 .1997	Gusts 60+ mph at Santa Ana.	
2.3-4.1998	Strong storm winds: gust 60 mph at Newport Harbor, 51 San Clemente.	
2.23-24.1998	Strong widespread storm winds 40-60 mph.	Trees and power lines knocked down. Damage.

3.28-29.1998	Strong storm winds in Orange County: sustained 30-40 mph. Gust 70 mph at Newport Beach, gust 60 Huntington Beach. Gusts to 60 mph in the mountains.	Trees down, power out, and damage across Orange and San Diego Counties. 1 illegal immigrant dead in Jamul.
12.9-10.1998	Santa Ana winds: gust 101 mph at Modjeska Canyon, gust 93 Fremont Canyon, 52 Santa Ana, 83 Ontario.	Trees and power lines down. Overturned vehicles. Property damage.
1.21.1999	Gust 80 mph in the Salton Sea area. Gusts up to 70 mph in the Coachella Valley, 47 Palm Springs, 36 Thermal.	
2.10-12.1999	Santa Ana winds: gust 85 mph at Rialto, gusts to 80 mph reported from I-8.	I-8 closed.
5.13.1999	Strong winds: sustained 61 mph at Borrego Springs.	Roof and tree damage.
11.22.1999	Gust 80 mph at Highland.	
12.3.1999	Santa Ana winds: gust 90 mph at San Bernardino, 68 Fontana.	
12.10-11.1999	Gust 60 mph at Palm Springs.	
12.21-22.1999	Santa Ana winds: gust 68 mph at Campo, 53 Huntington Beach, 44 Orange.	House and tree damage in Hemet.
1.5-6.2000	Santa Ana winds: gust 93 mph at Fremont Canyon, 60 Ontario, 58 Devore.	I-15 closed.
2.19.2000	Santa Ana winds: gust 92 mph at Fremont Canyon.	
2.21-23.2000	Winter storm winds: gust 75 mph along Highway 91.	Trees down at Lake Arrowhead.
4.1.2000	Santa Ana winds: gust 93 mph at Mission Viejo, 67 Anaheim Hills.	
4.17-18.2000	Late winter storm: gust 68 mph in the mountains of San Diego County.	
11.7.2000	Santa Ana winds: gust 82 mph at Fremont Canyon.	

12.25-26 .2000	Santa Ana winds: gust 87 mph at Fremont Canyon.	Damage and injuries in Mira Loma, and Orange and Riverside Counties.
1.2-3.2001	Santa Ana winds: gust 52 mph at Ontario, 60 Rialto.	Viejas Fire. 5,500 acres burned. Trees and power lines down.
1.10-11.2001	Winter storm: gust 71 mph at Phelan.	
2.7.2001	Winter storm: gusts 50 mph at Palm Springs and Thermal, 54 Fish Creek.	
11.27.2001	Santa Ana winds.	Damage.
12.7-8.2001	Santa Ana winds: gust 87 mph at Fremont Canyon.	Potrero Fire.
1.24.2002	Santa Ana winds.	
2.8-10.2002	Santa Ana winds: gust 80 mph at Descanso, 78 Fremont Canyon, 76 San Bernardino.	Fire in Fallbrook area.

Extreme Heat

Date(s)	**Weather**	**Adverse Impacts**
7.25.1891	109° in LA.	
5.27.1896	124° at Salton (City), the national maximum temperature for May.	
11.12.1906	105° at Craftonville (now Crafton Hills, near Redlands), the national maximum temperature for November.	
9.17.1913	110° at San Diego.	
2.25.1921	92° in LA, the hottest ever in February.	
12.8.1938	100° at La Mesa, the national maximum temperature for December.	
late 9.1939	Heat wave.	
7.10.1940	97° at Santa Ana, 96° Laguna Beach.	
9.2.1950	126° at Mecca, the national maximum temperature for September.	

8.31-9.7.1955	Heat wave. 110° in LA on 9.1, an all time record.	
7.17.1960	101° at Idyllwild.	
9.26.1963	113° at El Toro, the hot spot in the nation for the date. 111° at Lindbergh Field, highest temperature on record (95° at 8 am). 112° at El Cajon, 109° at Imperial Beach, 108° at Carlsbad, Oceanside, Santee and Chula Vista, 107° at SDSU, Lemon Grove, La Mesa and Escondido, Coronado (only) 96°.	Crop damage and animals killed. Schools dismissed, workers sent home, etc. Surf temperature dropped from 70° to 64° in one day due to the increased upwelling caused by offshore winds.
10.20-29.1965	A very long heat wave. A peak of 104° at San Diego on 10.22.	
11.1.1966	100° at LA, the all time November high.	
8.22.1969	110° at Cuyamaca.	
9.25.1970	97° at San Diego.	The Laguna Fire.
8.11-13.1971	100° at Palomar Mountain.	
9.12.1971	103° in LA.	
7.28-30.1972	100° at Palomar Mountain.	
7.10.1979	123° at Palm Springs.	
6.30.1985	100+° in parts of the city of San Diego.	Fire in Normal Heights - San Diego.
4.7.1989	Daily high temperatures broken at ALL recording stations in Southern California. Some highlights: 112° Palm Springs, 103° Riverside and Escondido, 101° Tustin, 95° Victorville, 93° San Diego, 76° Big Bear Lake. Part of major heat wave from late March into mid April.	
8.1.1993	123° at Palm Springs.	
7.27-29.1995	Heat wave: 123° at Palm Springs on 7.28-29. 120° at Coachella, 118° Palm Springs, 113° San Jacinto, 112° Riverside, 111° Banning, Moreno Valley, and Sun City. 110° at Yucaipa on 7.27.	

8.2-7.1997	Heat wave: 121° at Thermal, 113° Brea, 110° Riverside and Ontario, 101° Julian. Low of 93° at Palm Springs on 8.5.	5 deaths.
7.16.1998	120° at Palm Springs, 118° Borrego Springs (127° Death Valley).	
7.27.1998	123° at Thermal, 119° at Palm Springs, 118° Borrego Springs.	
8.30-31.1998	Record heat near coast. 112° at Yorba Linda , 110° Hemet and Riverside, over 100° in most of Orange County.	
5.7-9.2001	Heat wave. 109° at Palm Springs, Thermal, and Borrego Springs, 103° at Hemet, 102° San Bernardino.	

Extreme Cold

Date(s)	**Weather**	**Adverse Impacts**
12.23-30.1891	Cold wave.	0.5" thick ice in San Diego pools, 1" thick ice on oranges on trees in Mission Valley.
12.17.1897	26° at Riverside.	
1.6-7.1913	25° at San Diego on 1.7, the lowest temperature on record. 28°on 1.6 with a high temperature of only 45°, the lowest maximum temperature on record. Also on 1.7: 4° at Campo, 9° Cuyamaca, 13° Alpine , 15° Julian and Lakeside, 20° El Cajon, 22° Lemon Grove, 24° La Mesa, and 26° Chula Vista.	Killing freeze all over San Diego County and many crops and fruit lost. Water pipes frozen, trolley lines disrupted, fishing nets unusable. Ice skating in a San Diego fountain on ice 0.75" thick.
1.22.1937	19° at Palm Springs.	
1.4.1949	8° at Palomar Mountain.	
1.25.1949	-4° at Cuyamaca.	

1.5.1971	1° at Idyllwild.	
2.22-25.1987	Lows below 40° at Lindbergh for three consecutive days (coldest stretch since 1978).	
1.28.1988	-25° at Big Bear Lake.	
12.26.1997	0° at Big Bear Lake, 4° Big Bear Airport.	
12.7.1998	30° at Capistrano Beach and Dana Point, 29° at Mission Viejo and San Clemente.	
2.14.2001	0° at Wrightwood.	
1.30-31.2002	13° at Shelter Valley, 17° Campo, 22° Ramona, 28° Escondido.	Crops damaged in northern San Diego County.

High Surf, Stormy Seas, Tsunamis, Coastal Flooding and Erosion

Date(s)	**Weather**	**Adverse Impacts**
7.10.1855	An earthquake in LA causes two large swell to hit Dana Point.	
8.23.1856	A 7.8 magnitude earthquake in Japan. San Diego Bay rises 12' over the high water mark.	
5.27.1862	A 5.9 magnitude earthquake causes landslides into San Diego Bay and 3-4' wave runup.	
8.13.1868	Two earthquakes near 8.5 magnitude off Chile produce 2.64' wave height in San Diego.	
8.7.1906	Tsunami in San Diego from local sea quake.	

8.21.1934	Tsunami in San Diego with 20' maximum amplitude from local sea quake.	
12.12.1937	High surf.	Three piers ripped out from LA to Santa Barbara.
9.24.1939	Tropical storm. 50 mph winds. Extremely large waves.	48 dead from sinking boats. Harbors damaged.
4.1.1946	An 7.8 magnitude earthquake hits the Aleutian Islands. Newport Harbor shows a 5' drop in tide. San Pedro shows a 2.5' jump in tide.	
1.4-5.1959	High surf from a big storm.	Coastal damage in San Diego and Orange Counties. Boats and harbors damaged.
5.24.1960	An 8.5 magnitude earthquake hits Chile. Waves 8' above normal hit San Diego.	
2.9-11.1963	High surf from a big storm.	Damage to coastal homes and structures.
3.28.1964	An 8.4 magnitude earthquake hits Alaska. Tsunami reaches all of California. 2' maximum amplitude in San Diego, 6.4' rise in 10 minutes.	Damage.
11.29.1975	A 7.2 magnitude earthquake hits Hawaii. Tsunami hits Catalina. 2.4' maximum amplitude in San Diego.	Damage.
1.22-29.1983	A series of storms produces 16' surf.	Several piers collapsed. Damage to numerous businesses and homes. Several injuries to people swept off rocks.
2.14-17.1986	High surf from a big storm.	2 drowning deaths.
2.13-21.1980	Large waves hit coast. Coastal flooding at Mission Beach; water over boardwalk and into houses.	
4.30.1988	An earthquake 46 miles west of San Diego generates large surf of 14' with sets to 20'.	

8.17-19.1997	Tropical storm Ignacio produces 18' waves in Orange County.	
9.4.1997	Hurricane Linda produces 15-18' waves at the Wedge at Newport Beach.	
9.25-26.1997	Hurricane Nora produces waves 20'+ at Seal Beach.	Tidal flooding.
12.7-8.1997	Coastal erosion in Laguna Beach.	
1.30.1998	High surf.	Coastal damage.
2.23-24.1998	High surf from a big storm combined with high tides.	Coastal damage. Several homes destroyed in San Diego County.
10.27.2000	Heavy rain and very high tides.	Coastal inundation and flooding at Sunset Beach (Seal Beach).
1.9.2001	Very high tide, but only 4' surf.	Surfside in Seal Beach flooded.
11.27.2001	Strong winds off the coast.	Boat accident off Newport Beach.

Miscellaneous: Dense fog, barometric pressure, etc.

Date(s)	Weather	Adverse Impacts
2.17.1883	Highest barometric pressure at San Diego: 30.53".	
3.3.1983	Lowest barometric pressure at San Diego: 29.37".	
12.15.1969	Dense fog in Orange County.	100+ vehicle pile up on I-5.
11.10.1980	Dense fog in San Bernardino.	24 vehicle pile up on I-15. 7 dead, 17 injured.
2.14.2000	Dense fog at Cajon Pass.	71 vehicle pile up on I-15. 22 injured. I-15 closed for 4 hours.
10.24.2001	Dense fog in Inland Empire.	39 vehicles pile up in 13 separate accidents on I-215 in Perris. 8 injured.

Resources

The National Weather Service should be your first resource to answer weather-related questions of local interest. Please call us for answers to questions, clarifications, or interviews at: **858-675-8707**.

Our web site is a good first stop for weather information in general and our Southern California weather in particular: www.wrh.noaa.gov/sandiego. Please familiarize yourself with the web site. Suggestions and feedback are welcome. Our Spanish language web site is available by clicking "En español" from the home page. This site and the product translations found on it are exclusive services of the San Diego office.

Nuestro sitio del web es el mejor recurso principal para obtener información del tiempo en general, o información del tiempo particular de California del Sur. Esperamos que se familiarize con el sitio; se encuentra al apresionar: "en español" desde la página principal www.wrh.noaa.gov/sandiego. Este sitio y las traducciones de productos contenidas son servicios únicos de la oficina de San Diego. Sugerencias y comentarios siempre son bienvenidos.

A complete list of web sites to National Weather Service offices and organizations nationwide are easily found by clicking on "organization" (**www.wrh.noaa.gov/wrhq/nwspage.html**) near the top of our home page. Contacts and phone numbers for each office or center can be found on the respective web sites. Media contacts for answers to questions and interviews are available through our web site by clicking on "Media," then "Media Resources." An excellent weather tutorial can be found at: **www.srh.weather.gov/ftproot/jetstream/index.htm.**

For a comprehensive list of the best weather resources on the web, see Appendix G - Web Sites for Weather Information.

Appendix A - Product Cross Reference

The following chart is a cross references for weather products issued by the NWS with the World Meteorological Organization (WMO) headers. The NWS identifier used is the final five or six letters of the complete eight or nine digit identifier.

Product	**NWS Header**	**WMO Header**	**Issuance Times**
Area Forecast Discussion	**AFDSAN**	FXUS66	330 am, 230 pm, 930 pm, and as needed
Climatological Report (Monthly)	CLMSAN	CSUX46	1st day of the month
Climatological Report (Daily)	CLI (SAN, SNA, FUL, RAL, PSP)	CDUS46	2 am, 4 pm
Coastal Flood Warning	CFWSGX	FZUS68	as needed
Coastal Waters Forecast	CWFSGX	FZUS56	330 am/pm, 930 am/pm PDT (230 am/pm, 830 am/pm PST)
Coastal Weather Observations	CGRSGX	SXUS8	7 am, 10 am, 1 pm, 4 pm, 7 pm, 10 pm, (possibly 1 am, 4 am)
Earthquake Report	EQREQI	SEUS61	as needed
Fire Weather Forecast	FWFSGX	FNUS56	230 pm, 330 am
Flash Flood Warning	FFWSGX	WGUS56	as needed
Flood Watch	FFASGX	WGUS46	as needed
Flash Flood Potential Index	ESFSGX	FGUS76	4 am/pm (1 Jun-30 Sep)
Flood Statement	FLSSGX	WGUS46	as needed
Flood Warning	FLWSGX	WGUS46	as needed
Hazardous Weather Outlook	HWOSGX	FLUS46	6 am
Marine Weather Statement	MWSSGX	FZUS76	as needed
Mexican Weather Roundup	SWRMX	AXUS46	hourly
Non Precipitation Warnings/ Watches/ Advisories	NPWSGX	WWUS45	as needed

Offshore Waters Forecast	OFFPZ6	FZPN26	330 am/pm, 930 am/pm
Public Information Statement	PNSSGX	ABUS34	as needed
Quantitative Precipitation Forecast	QPSSGX	FSUS46	4 am/pm (1 Nov - 15 Apr)
Record Event Report	RERSAN	SXUS99	as needed
Red Flag Warning	RFWSGX	FXUS70	as needed
Regional Max/Min Temp and Precip Table	RTPSGX	ASUS66	530 am, 430 pm, 530 pm, and as needed
River Statement	RVSSGX	RWUS15	as needed
Tabular State Forecast for California	SFTSGX	FOUS45	330 am, 230 pm
Severe Local Storm Watch and Areal Outlook	SLSCA	WWUS32	as needed
Severe Thunderstorm Warning	SVRSGX	WUUS56	as needed
Severe Weather Statement	SVSSGX	WWUS34	as needed
Short Term Forecast	NOWSGX	FPUS76	as needed
Special Marine Warning	SMWSGX	WMUS1	as needed
Special Weather Statement	SPSSGX	WWUS35	as needed
State Weather Roundup	SWRCA	ASUS46	hourly
Storm Report	LSRSGX	WWUS30	as needed
Surf Forecast	SRFSGX	FZUS56	2 am/pm
Tornado Warning	TORSGX	WFUS56	as needed
Tsunami Warning	TSUWCA	WEPA41	as needed
Winter Weather Warnings/ Watches/Advisories	WSWSGX	WWUS46	as needed
Zone Forecast	ZFPSGX	FPUS56	330 am, 230 pm, and as needed

Appendix B - Climate Records

Climate records are so numerous and voluminous, they are not included here. Southern California archives of climate normals are available on the Western Regional Climate Center's web site at:
www.wrcc.dri.edu/summary/climsmsca.html
For more detailed records from San Diego - Lindbergh Field, click on:
www.wrh.noaa.gov/sandiego/climate/cli-monthly.htm
For a narrative describing the monthly climate for the city of San Diego, click on:
www.wrh.noaa.gov/sandiego/climate/san-san-month.htm

While climate normals can be found on the Internet, most detailed (daily and hourly) historical weather conditions cannot. Detailed data are not kept or archived at the NWS in San Diego, except for daily data for San Diego-Lindbergh Field and Rancho Bernardo. Some daily climate data are made available through our web site for Fullerton, Santa Ana, Ontario, Riverside, Palm Springs, Thermal, San Diego, Ramona, and Campo. Others may soon be added to this list.

Climate data are available in hourly, daily, monthly, or seasonal breakdowns for over 40 locations in our area of responsibility and hundreds more locations in the western U.S. These data can be obtained through the Western Regional Climate Center in Reno, Nevada, and require a special request and a small fee. Contact them directly:

Western Regional Climate Center
2215 Raggio Parkway
Reno, Nevada 89512

Internet address: **www.wrcc.dri.edu**

email: wrcc@dri.edu
phone: 775-674-7010
fax: 775-674-7016

Appendix C - Weather Glossary

ACID RAIN: Cloud or rain droplets containing pollutants, such as oxides of sulfur and nitrogen, to make them acidic (eg. pH <7.0). < 7.0)

ADVECTION: The horizontal transport of air or atmospheric properties. Commonly used with temperatures, i.e., "warm air advection".

ADVISORY: Advisories are issued for weather situations that cause significant inconveniences but do not meet warning criteria and, if caution is not exercised, could lead to life-threatening situations. Advisories are issued for significant events that are occurring, are imminent, or have a very high probability of occurrence.

AIR MASS: A large body of air having similar horizontal temperature and moisture characteristics.

ALBEDO: The percentage of light reflected by an object.

ALTOCUMULUS: Mid-altitude clouds with a cumuliform shape.

ALTOSTRATUS: Mid-altitude clouds with a flat sheet-like shape.

ANEMOMETER: An instrument that measures wind speed.

ANTICYCLONE: A large area of high pressure around which the winds blow clockwise in the Northern Hemisphere.

ASOS: Automated Surface Observing System. Observes sky conditions, temperature and dew point, wind direction and speed, and barometric pressure.

ATWC: Alaska Tsunami Warning Center, located in Palmer, AK. A tsunami warning for Southern California will likely come from this center.

AVHRR: Advanced Very High Resolution Radiometer. Main sensor on U.S. polar orbiting satellites.

AVN: Aviation Model generated every 12 hours by NCEP.

AWIPS: Advanced Weather Information Processing System. NWS computer system integrating graphics, satellite and radar imagery.

BACKING WINDS: A counterclockwise change in wind direction. Backing winds with height are indicative of cold air advection (CAA).

BAR: An obstacle formed at the shallow entrance to the mouth of a river or bay.

BAROMETER: An instrument for measuring atmospheric pressure.

BLIZZARD: Snow with winds in excess of 35 mph and visibilities of 1/4 mile or less, for an extended period of time (e.g. > 3 hours).

BLOWING DUST: Reduction of visibility by strong winds blowing across dry ground with little or no vegetation. Visibilities of 1/8 mile or less over a widespread area are criteria for a Blowing Dust Advisory.

BROKEN CLOUDS: Clouds which cover between 6/10 and 9/10 of the sky.

CEILING: The height of the lowest layer of clouds, when the sky is broken or overcast.

CHANCE: A 30, 40 or 50 percent chance of occurrence of measurable precipitation.

CHINOOK WIND: A foehn wind on the east side of the Rocky Mountains.

CIRRIFORM: High altitude ice clouds with a very thin wispy appearance.

CIRROCUMULUS: Cirrus clouds with vertical development.

CIRROSTRATUS: Cirrus clouds with a flat sheet-like appearance.

CIRRUS: High clouds, usually above 18,000 feet, composed of ice crystals.

CLEAR: Sky condition of less than 1/10 cloud coverage.

CLIMATE: The historical record of average daily and seasonal weather events.

CLOSED LOW: See Cutoff Low below.

COASTAL FLOODING: The inundation of land areas along the coast caused by sea water above normal tidal actions.

COASTAL FORECAST: A forecast of wind, wave and weather conditions between the coastline and 60 miles offshore.

COLD FRONT: The boundary between a cold air mass that is advancing and a relatively warmer airmass. Generally characterized by steady precipitation followed by showery precipitation.

COMBINED SEAS: The combined height of swell and wind waves.

CONDENSATION: The process of gas changing to liquid.

CONTINENTAL AIR MASS: A dry air mass originating over a large land area.

CORIOLIS FORCE: An apparent force caused by the rotation of the Earth. In the Northern Hemisphere winds are deflected to the right, and in the Southern Hemisphere to the left.

CUMULONIMBUS CLOUD: A vertically developed cloud, often capped by an anvil shaped cloud. Also called a thunderstorm cloud, it is frequently accompanied by heavy showers, lightning, thunder, and sometimes hail or gusty winds.

CUMULUS CLOUD: A cloud in the shape of individual detached domes, with a flat base and a bulging upper portion resembling cauliflower.

CUT OFF LOW: An area of low pressure cut off from its associated jet stream.

CYCLONE: An area of low pressure around which winds blow counterclockwise in the Northern Hemisphere. Also the term used for a hurricane in the Indian Ocean and in the Western Pacific Ocean.

DENSE FOG ADVISORY: Issued when fog reduces visibility to 1/8 mile or less over a widespread area.

DEW: Moisture that has condensed on objects near the ground, whose temperatures have fallen below the dew point temperature.

DEW POINT: The temperature to which the air must be cooled for water vapor to condense.

DOPPLER RADAR: A type of weather radar that determines whether atmospheric motion is toward or away from the radar. It uses the Doppler effect to measure the velocity of particles suspended in the atmosphere.

DOWNBURST: A severe localized downdraft from a thunderstorm.

DRIZZLE: Small, slowly falling water droplets, with diameters between .2 and .5 millimeters.

DUST DEVIL: A small, rapidly rotating wind that is made visible by the dust, dirt or debris it picks up. Also called a whirlwind, it develops best on clear, dry, hot afternoons.

EBB CURRENT: Movement of a tidal current away from shore or down a tidal river or estuary.

ECMF: European Centre for Meteorology Forecast model.

EL NIÑO: A major warming of the equatorial waters in the Pacific Ocean. El Niño events usually occur every 3 to 7 years, and are characterized by shifts in "normal" weather patterns.

ENSO: El Niño-Southern Oscillation.

ETA: "Eta" (from Greek) model generated every 12 hours by NCEP

FAIR: Less than 4/10 opaque cloud cover, no precipitation, and no extremes in temperature, visibility or winds.

FETCH: The area in which ocean waves are generated by the wind. Also refers to the length of the fetch area, measured in the direction of the wind.

FLASH FLOOD: A flood that occurs within a few hours (usually less than six) of heavy or excessive rainfall, dam or levee failure.

FLOOD: High flow, overflow or inundation of a normally dry area which causes or threatens damage.

FLOOD STAGE: The level of a river or stream at which considerable inundation of surrounding areas will occur.

FOËHN: A warm dry wind on the lee side of a mountain range. The heating and drying are due to adiabatic compression as the wind descend downslope.

FOG: The visible aggregate of minute water droplets suspended in the atmosphere near the earth's surface. Essentially a cloud whose base is at the earth's surface, limiting visibility.

FREEZING LEVEL: The altitude in the atmosphere at which the temperature drops to 32 degrees F.

FREEZING RAIN: Rain which falls as liquid then freezes upon impact, resulting in a coating of ice on exposed objects.

FRONT: The transition zone between two distinct air masses. The basic frontal types are cold fronts, warm fronts and occluded fronts.

FROST: The covering of ice that is formed on exposed surfaces whose temperature falls below freezing.

FUJITA SCALE: System developed by Dr. Theodore Fujita to classify tornadoes based on wind damage. Scale is from F0 for weakest to F5 for strongest tornadoes.

FUNNEL CLOUD: A rotating, cone-shaped column of air extending downward from the base of a thunderstorm. When it reaches the ground it is called a tornado.

GALE: Wind speeds from 39 to 54 mph (34 to 47 knots).

GEOSTATIONARY SATELLITE: A satellite that rotates at the same rate as the earth, remaining over the same spot above the equator.

GREENWICH MEAN TIME (GMT): Time standard based upon the Prime Meridian and used for most meteorological applications and activities. See UTC and ZULU.

GOES: Geostationary Operational Environmental Satellite

GRAUPEL: Precipitation in the form of soft irregular balls of ice particles having a snow-like structure. Also called soft hail, snow pellets, or tapioca snow.

GREENHOUSE EFFECT: The warming of the atmosphere by the trapping of long wave radiation being radiated to space. The gases most responsible for this effect are water vapor and carbon dioxide.

GROUND FOG: Fog produced over the land by the cooling of the lower atmosphere as it comes in contact with the ground. Also known as radiation fog, and in parts of California as tule fog.

GUST: A brief sudden increase in wind speed. Generally the duration is less than 20 seconds and the fluctuation greater than 10 mph.

GUST FRONT: The leading edge of the downdraft from a thunderstorm.

HAIL: Precipitation in the form of balls or irregular lumps of ice.

HALOS: Rings or arcs that seem to encircle the sun or moon. They are caused by the refraction of light through the ice crystals in cirrus clouds.

HAZE: Fine dry or wet dust or salt particles in the air that reduce visibility.

HEAT INDEX: An index that combines air temperature and humidity to give an apparent temperature (e.g. how hot it "feels").

HIGH: The center of an area of high pressure, usually accompanied by anticyclonic and outward wind flow. Also known as an anticyclone.

HIGH WIND: Sustained winds greater than or equal to 40 mph or gust greater than or equal to 58 mph.

HUMIDITY: The amount of water vapor in the atmosphere. (See relative humidity).

HURRICANE: A severe tropical cyclone with wind speeds in excess of 74 mph (64 knots).

INDIAN SUMMER: An unseasonably warm period near the middle of autumn, usually following a substantial period of cool weather.

INVERSION: An increase in temperature with height. The reverse of the normal cooling with height in the atmosphere.

ISOBAR: A line of equal barometric pressure on a weather map.

ITCZ: Inter-tropical Convergence Zone. The region where the northeasterly and southeasterly trade winds converge, forming an often continuous band of clouds or thunderstorms near the equator.

JET STREAM: Strong winds concentrated within a narrow band in the atmosphere. The jet stream often "steers" surface features such as front and low pressure systems.

KATABATIC WIND: Local winds a result of cold, dense air flowing downhill.

KNOT: One nautical mile per hour (1.15 mph).

LAND BREEZE: A wind that blows from the land towards a body of water. Also known as an offshore breeze.

LA NIÑA: A cooling of the equatorial waters in the Pacific Ocean.

LAPSE RATE: The change in temperature with altitude in the atmosphere.

LIGHTNING: An electrical discharge from a thunderstorm.

LIKELY: In probability of precipitation statements, the equivalent of a 60 or 70 percent chance.

LOW: The center of an area of low pressure, usually accompanied by cyclonic and inward wind flow. Also known as a cyclone.

MACROBURST: Large downbursts with a 2.5 mi or greater outflow diameter and damaging winds lasting 5 to 20 minutes.

MARITIME AIR MASS: Moist air mass originating over the ocean.

METEOROLOGY: The study of the atmosphere and atmospheric phenomena.

MICROBURST: A strong localized downdraft from a thunderstorm with peak gusts lasting 2 to 5 minutes.

MILLIBAR: A unit of atmospheric pressure. 1 mb = 100 Pa (pascal). Normal surface pressure is approximately 1013 millibars.

MONSOON: A persistent seasonal wind, often responsible for seasonal precipitation regime.

MOS: Model Output Statistics.

MRF: Medium Range Forecast model generated every 12 hours by NCEP.

MSLP: Mean sea level pressure.

NCDC: National Climatic Data Center. Located in Asheville, North Carolina, the agency that archives climatic and forecast data from the National Weather Service.

NCEP: National Centers for Environmental Prediction. Central computer and communications facility of the National Weather Service; located near Washington, DC.

NEXRAD: NEXt Generation RADar. A NWS network of about 140 Doppler radars operating nationwide.

NGM: Nested Grid Model generated every 12 hours by NCEP.

NHC: National Hurricane Center. The office of the National Weather Service in Miami that is responsible for tracking and forecasting tropical cyclones.

NOAA: National Oceanic and Atmospheric Administration. A branch of the US Department of Commerce, NOAA is the parent organization of the National Weather Service.

NOAA WEATHER WIRE (NWWS): Mass dissemination via satellite of National Weather Service products to the media and public.

NOAA WEATHER RADIO (NWR): Continuous, 24 hour a day VHF broadcasts of weather observations and forecasts directly from National Weather Service offices. A special tone allows certain receivers to alarm when watches or warnings are issued.

NUMERICAL WEATHER PREDICTION (NWP): Forecasting weather by the use of numerical models, run on high speed computers. Most of the NWP for the National Weather Service is done at the National Centers for Environmental Prediction (NCEP).

NWS: National Weather Service.

OCCLUDED FRONT: A complex frontal system that occurs when a cold front overtakes a warm front. Also known as an occlusion.

OFFSHORE BREEZE: A wind that blows from the land towards a body of water. Also known as a land breeze.

OFFSHORE FORECAST: A marine weather forecast for the waters between 60 and 250 miles off the coast.

OMEGA: A term used to describe vertical motion in the atmosphere. The "omega equation" used in numerical weather models is composed of two terms, the "differential vorticity advection" term and the "thickness advection" term. Put more simply, omega is determined by the amount of spin (or large scale rotation) and warm (or cold) advection present in the atmosphere. On a weather forecast chart, high values of omega (or a strong omega field) relate to upward vertical motion in the atmosphere. If this upward vertical motion is strong enough and in a sufficiently moist airmass, precipitation results.

ONSHORE BREEZE: A wind that blows from a body of water towards the land. Also known as a sea breeze.

OROGRAPHIC UPLIFT: The vertical forcing of air by terrain features such a hills or mountains. This can create orographic clouds and/or precipitation.

OUTFLOW: Air that flow outward from a thunderstorm.

OVERCAST: Sky condition when greater than 9/10 of the sky is covered.

OZONE: A form of oxygen containing three molecules, usually found in the stratosphere, and responsible for filtering out much of the sun's ultraviolet radiation.

PACIFIC HIGH: A semipermanent anticyclone located in the Eastern North Pacific.

PARTLY CLOUDY: Sky condition when between 3/10 and 7/10 of the sky is covered.

PoPs: Probability of Precipitation.

PRECIPITATION: Liquid or solid water molecules that fall from the atmosphere and reach the ground.

PRESSURE: The force exerted by the interaction of the atmosphere and gravity. Also known as atmospheric pressure.

PTWC: Pacific Tsunami Warning Center, located in Honolulu, HI.

QPF: Quantitative Precipitation Forecast. A forecast of expected precipitation amounts.

RADAR: An instrument used to detect precipitation by measuring the strength of the electromagnetic signal reflected back. (RADAR= Radio Detection and Ranging)

RADIATION FOG: See ground fog.

RADIOSONDE: An instrument attached to a weather balloon that transmits pressure, humidity, temperature and winds as it ascends.

RAIN: Liquid water droplets that fall from the atmosphere, having diameters greater than drizzle.

RAINBOW: Optical phenomena when light is refracted and reflected by moisture in the air into concentric arcs of color.

RELATIVE HUMIDITY: The amount of water vapor in the air, compared to the amount the air could hold if it was totally saturated. (Expressed as a percentage).

RIDGE: An elongated area of high pressure in the atmosphere.

RUC: Rapid Update Cycle model generated every 3 hours.

SANTA ANA WINDS: Relatively warm, dry winds that blow into Southern California coastal areas from an anticyclone located over the high deserts of California or Nevada. The warmth and dryness are due to compressional heating. See also Diablo winds.

SCATTERED CLOUDS: Sky condition when between 1/10 and 5/10 are covered..

SEA BREEZE: A wind that blows from a sea or ocean towards a land mass. Also known as an onshore breeze.

SEA SURFACE TEMPERATURE (SST): Surface temperature of ocean water. This data is collected using IR satellite imagery, buoy and ship data.

SEVERE THUNDERSTORM: A strong thunderstorm with wind gusts in excess of 58 mph (50 knots) and/or hail with a diameter of 3/4" or more.

SHOWER: Precipitation that is intermittent, both in time, space or intensity.

SLEET: A type of frozen precipitation, consisting of small transparent pellets.

SLIGHT CHANCE: In probability of precipitation statements, usually equivalent to a 20 percent chance.

SMALL CRAFT: Generally a vessel under 65 feet in length.

SMALL CRAFT ADVISORY: Winds in excess of 22 knots (25 mph), and less than 34 knots (39 mph), that may cause hazardous conditions for operators of small vessels.

SMOG: Pollution formed by the interaction of pollutants and sunlight (photochemical smog), usually restricting visibility, and occasionally hazardous to health.

SNOW: Frozen precipitation composed of ice particles in complex hexagonal patterns.

SNOW ADVISORY: An advisory issued when snow is expected to create hazardous or restricted travel conditions, but not as severe as expected with a winter storm.

SNOW FLURRIES: Light snow showers, usually of an intermittent nature with no measurable accumulation.

SOUTHERN OSCILLATION: A periodic reversal of the pressure pattern across the tropical Pacific Ocean during El Nino events.

SPC: Storm Prediction Center. Located in Norman, OK. This office is responsible for monitoring and forecasting severe convective weather in the continental U.S. This includes the issuance of Tornado and Severe Thunderstorm Watches.

SPRING TIDE: Semi-monthly tide of increased height due to the new or full moon.

SQUALL LINE: A non-frontal band, or line, of thunderstorms.

STATIONARY FRONT: A transition zone between air masses, with neither advancing upon the other.

STORM: In marine usage, winds 48 knots (55 mph) or greater.

STORM SURGE: A rise of the sea, preceding a storm (usually a hurricane) due to the winds of the storm and low atmospheric pressure.

STRAIGHT LINE WINDS: Thunderstorm winds most often found with the gust front. They originate from downdrafts and can cause damage which occurs in a "straight line", as opposed to tornadic wind damage which has circular characteristics.

STRATUS: Very flat low level clouds.

SUBSIDENCE: Sinking air that is associated with warming air and little cloud formation.

SUBTROPICAL JET: The branch of the jet stream that is found in the lower latitudes.

SUSTAINED WINDS: The wind speed obtained by averaging the observed values over a one minute period.

SWELLS: Ocean waves of regular and longer duration than wind waves.

THERMAL: Small rising column of air due to surface heating.

THUNDER: The sound caused by a lightning stroke as it heats the air and causes it to rapidly expand.

THUNDERSTORM: A storm with lightning and thunder, produced by a cumulonimbus cloud, usually producing gusty winds, heavy rain and sometimes hail.

TORNADO: A violent rotating column of air, in contact with the ground, extending as a pendant from a cumulonimbus cloud. A tornado does not require the visible presence of a funnel cloud.

TRADE WINDS: Persistent tropical winds that blow from the subtropical high pressure centers towards the equatorial low.

TROPICAL DEPRESSION: Tropical mass of thunderstorms with a cyclonic wind circulation and winds between 20 and 34 knots.

TROPICAL DISTURBANCE: An organized mass of tropical thunderstorms, with a slight cyclonic circulation, and winds less than 20 knots.

TROPICAL STORM: An organized cyclone in the tropics with wind speed between 35 and 64 knots.

TROUGH: An elongated area of low pressure at the surface or aloft.

TSUNAMI: An ocean wave generated by a submarine earthquake, volcano or landslide. (Also known as a seismic sea wave, and incorrectly as a tidal wave).

TULE FOG: Radiation fog in the Central Valley. It forms during night and morning hours in late fall and winter months following the first significant rainfall. A leading cause of weather related casualties in California.

TURBULENCE: Disrupted flow in the atmosphere that produces gusts and eddies.

TYPHOON: A hurricane that forms in the Western Pacific Ocean.

UTC: In 1970 the Coordinated Universal Time system was devised by an international advisory group of technical experts within the International Telecommunication Union (ITU). The ITU felt it was best to designate a single abbreviation for use in all languages in order to minimize confusion. Since unanimous agreement could not be achieved on using either the English word order, CUT, or the French word order, TUC, the acronym UTC was chosen as a compromise.

UKMET: United Kingdom forecast model.

UPWELLING: The rising of cold water from the deeper areas of the ocean to the surface. This phenomena often occurs along the California coast during the summer and is an important component in the development of coastal stratus clouds.

VEERING WINDS: A clockwise change in wind direction. Veering winds with height are indicative of warm air advection (WAA).

VIRGA: Precipitation falling from the base of a cloud and evaporating before it reaches the ground.

VISIBILITY: The horizontal distance an observer can see and identify a prominent object.

VORTICITY: A measure of the amount of "spin" (or rotation) in the atmosphere.

WARM FRONT: A boundary between a warm air mass that is replacing a cooler air mass.

WARNING STAGE: The level of a river or stream which may cause minor flooding, and at which concerned interests should take action.

WARNING: Forecast issued when a particular hazard is "imminent" or already occurring (e.g., tornado warning, flash flood warning).

WATCH: Forecast issued well in advance to alert the public of the possibility of a particular hazard (e.g. tornado watch, flash flood watch).

WATERSPOUT: A column of rotating air over a body of water (ie. a tornado over the water).

WIND ADVISORY: Sustained winds 30 to 39 mph and/or gusts to 57 mph in coastal and valley areas. Sustained winds 35 to 44 mph and/or gusts to 57 mph in the mountains and deserts.

WIND SHEAR: The change of wind speed or direction with distance, usually vertical.

WIND VANE: An instrument that determines the direction from which a wind is blowing.

WIND WAVES: Short period and irregular waves created by the flow of air over the water.

WIND CHILL FACTOR: The amount of cooling one "feels" due to the combination of wind and temperature.

WINTER STORM: A heavy snow event.

ZULU: Equivalent to UTC or Greenwich Mean Time (GMT).

Appendix D - Warning and Advisory Criteria

WIND

Location	Wind Advisory	High Wind Warning
Coastal Areas and Valleys	Sustained 30 mph (26 kt) or more and/or gusts 35 mph (30 kt) or more	Sustained 40 mph (35 kt) or more and/or gusts 58 mph (50 kt) or more
Desert and Mountains below 7000 ft	Sustained 35 mph (30 kt) or more and/or gusts 45 mph (39 kt) or more	Sustained 45 mph (39 kt) or more and/or gusts 58 mph (50 kt) or more
Mountains above 7000 ft	Sustained 45 mph (39 kt) or more and/or gusts 55 mph (48 kt) or more	Sustained 55 mph (48 kt) or more and/or gusts 75 mph (65 kt) or more

FOG

Location	Dense Fog Advisory
Usually for 2 or more locations	Less than ½ mile visibility for any length of time

WINTER WEATHER

Location	Snow Advisory	Heavy Snow Warning
Mountains above 7000 ft	4-7" in 12 hours	12" in 12 hours or 18" in 24 hours
Mountains below 7000 ft (3000-7000 ft)	4-7" in 12 hours	8" in 12 hours or 12" in 24 hours
Apple and Yucca Valleys	1-4" in 12 hours	4" in 12 hours or 6" in 24 hours
Foothills	1-4" in 12 hours	4" in 12 hours or 6" in 24 hours

Location	Wind Chill Warning	Wind Chill Advisory	Blizzard Warning	Blowing Snow Advisory
any	-20 degree wind chill	-10 to -19 degree wind chill	Combination of sustained wind 35 mph (30 kt) or more with visibility 1/4 mile or less for 3 hours or more	Widespread visibilities ½ mile or less

Location	Freezing Rain or Drizzle Advisory	Ice Storm Warning
any	Freezing rain or drizzle accumulations of a trace to less than 1/4"	Freezing rain or drizzle accumulations of 1/4" or more

SEVERE THUNDERSTORM - TORNADO

Location	Severe Thunderstorm Warning	Tornado Warning
any	Hail 3/4" or larger and/or winds 58 mph (50 kt) sustained or gusts	If tornado is sighted or if radar or other data suggest existence or formation is likely

TEMPERATURE

Location	Excessive Heat Warning	Frost Advisory	Freeze Warning
Coastal Sections	Heat Index 105 degrees or more	Widespread temps from 28 to 32 degrees	Widespread temps 28 degrees or less
Valleys	Heat Index 110 degrees or more	Widespread temps from 28 to 32 degrees	Widespread temps 28 degrees or less
Apple and Yucca Valleys	Heat Index 120 degrees or more	The 1st and 2nd time temp is forecast to be 32 degrees or less for 2 or more consecutive hours or anytime between 1 Mar and 15 Nov	The 1st and 2nd time temp is forecast to be 28 degrees or less for 2 or more consecutive hours or anytime between 1 Mar and 15 Nov
Lower Deserts	Heat Index 120 degrees or more	Widespread temps from 28 to 32 degrees	Widespread temps 28 degrees or less
Mountains (> 3 kft)	Heat Index 105 degrees or more	Not issued	Not issued

MARINE

Small Craft Advisory (including for hazardous seas)	Gale Warning	Storm Warning
Wind 21 to 33 kt and/or combined seas 10 ft or more	Wind 34 to 47 kt	Wind 48 kt or more

Heavy Surf Advisory	Tidal Overflow Statement
Widespread breakers of 7 ft or more. If high tides will be 5 ½ ft or more, a call to action to protect beach property is required	Tides of 7 ft or more with little or no wave or wind action. With higher wave or wind action, use Coastal Flooding products

Appendix E — Southern California Weather Safety Tips

For more information about these and other hazards, visit: **www.nws.noaa.gov/safety.html**

Flash Floods

- Get out of areas subject to flooding, such as dips, low spots, canyons, washes, etc. Climb to higher ground.
- Do not let children play near storm drains.
- Avoid already flooded and high velocity flow areas. Do not attempt to cross flowing streams.
- If driving, be aware that the road bed may not be intact under flood waters. Turn around and go another way. Never drive through flooded roadways.
- If the vehicle stalls, leave it immediately and seek higher ground. Rapidly rising water may engulf the vehicle and its occupants and sweep them away.
- Be especially cautious at night when it is harder to recognize flood dangers.
- Do not camp or park your vehicle along streams and washes, particularly during threatening conditions.
- If advised to evacuate, do so immediately.

Lightning

- Postpone outdoor activities if thunderstorms are imminent. This is your best way to avoid being caught in a dangerous situation.
- Move to a sturdy building or car. Do not take shelter in small sheds, under isolated trees, or in convertible automobiles. Stay away from tall objects such as towers, fences, telephone poles, and power lines.
- If lightning is occurring and a sturdy shelter is not available, get inside a hard top automobile and keep the windows up. Avoid touching any metal.
- Utility lines and metal pipes can conduct electricity. Unplug appliances not necessary for obtaining weather information. Avoid using the telephone or any electrical appliances. Use phones ONLY in an emergency.
- Do not take a bath or shower during a thunderstorm.
- Turn off air conditioners. Power surges from lightning can cause serious damage.

<u>If caught outdoors and no shelter is nearby:</u>

- Find a low spot away from trees, fences, and poles. Make sure the place you pick is not subject to flooding.
- If you are in the woods, take shelter under the shorter trees.
- If you feel your skin tingle or your hair stand on end, squat low to the ground on the balls of your feet. Place your hands over your ears and your head between your knees. Make yourself the smallest target possible and minimize your contact with the ground. DO NOT lie down.
- If you are boating or swimming, get to land and find shelter immediately!

Tornadoes

- In a home or building, move to a pre-designated shelter, such as a basement.
- If an underground shelter is not available, move to a small interior room or hallway on the lowest floor and get under a sturdy piece of furniture. Put as many walls as possible between you and the outside.
- Stay away from windows.
- Get out of automobiles.
- Do not try to outrun a tornado in your car; instead, leave it immediately for safe shelter.
- If caught outside or in a vehicle, lie flat in a nearby ditch or depression and cover your head with your hands.
- Be aware of flying debris. Flying debris from tornadoes causes most fatalities and injuries.
- Mobile homes, even if tied down, offer little protection from tornadoes. You should leave a mobile home and go to the lowest floor of a sturdy nearby building or a storm shelter.

Winter Storms and Extreme Cold

<u>Outside</u>:

- Find shelter to stay dry. Cover all exposed body parts.
- If no shelter, build a lean-to, windbreak or snow cave for protection from the wind. Build a fire for heat and to attract attention. Place rocks around the fire to absorb and reflect heat.
- Melt snow for drinking water. Eating snow will lower your body temperature.

<u>In a Vehicle</u>:

- Stay in the vehicle. You will become quickly disoriented in wind-driven snow and cold.
- Run the motor about 10 minutes each hour for heat.
- Open the window a little for fresh air to avoid carbon monoxide poisoning.
- Make sure the exhaust pipe is not blocked.
- Be visible to rescuers. Turn on the dome light at night when running the engine.
- Tie a colored cloth, preferably red, to your antenna or door.
- After snow stops falling, raise the hood to indicate you need help.
- Exercise. From time to time, move arms, legs, fingers and toes vigorously to keep blood circulating and to keep warm.

<u>Inside</u>:

- Stay inside.
- When using alternate heat from a fireplace, wood stove, space heater, etc., use fire safeguards and properly ventilate.
- If no heat: close off unneeded rooms, stuff towels or rags in cracks under doors, cover windows at night. Eat and drink. Food provides the body with energy for producing its own heat. Keep the body replenished with fluids to prevent dehydration. Wear layers of loose-fitting, lightweight, warm clothing. Remove layers to avoid overheating, perspiration and subsequent chill.

Extreme Heat

- Slow down. Limit strenuous activities to the coolest time of the day.
- Dress for summer. Wear lightweight, light-colored clothing.
- Reduce the consumption of proteins to slow down metabolism and water loss.
- Drink plenty of water even if you are not thirsty. Avoid alcoholic beverages.
- Spend more time in air-conditioned places.
- Avoid too much exposure to the sun. Sunburn reduces the body’s ability to dissipate heat.

Boating

- Check NOAA Weather Radio for latest warnings and forecasts.
- Watch for signs of approaching storms: dark, threatening clouds that may foretell a squall or thunderstorm, a steady increase in wind or sea lightning flashes.
- An increase in wind opposite in direction to a strong tidal current may lead to steep waves capable of broaching a boat.
- Heavy static on your AM radio may be an indication of nearby thunderstorm activity.
- If a thunderstorm is approaching, head for shore if possible. Get out of your boat and away from the water. Find shelter immediately.
- If a thunderstorm catches you while afloat, remember that gusty winds and lightning pose a threat to safety. Put on your personal flotation device and prepare for rough seas. Stay below deck if possible. Keep away from metal objects that are not grounded to the boat's protection system. Don't touch more than one grounded object at the same time (or you may become a shortcut for electrical surges passing through the protection system).

Surf and Rip Currents

- Know how to swim.
- Always swim at guarded beaches and heed the beach patrol.
- Remain calm. If caught in a rip current remember it will not pull you under.
- Swim out of the current. Since the currents are relatively narrow, you can escape the flow by swimming parallel to the shore until you break free, then swim diagonally toward the shore.
- Float if you cannot swim out of the current. Float until it dissipates, then swim diagonally toward the shore or float and summon the beach patrol by waving your hands.
- Use a flotation device if you attempt to rescue someone.

Appendix F — Charts and Tables

Temperature Conversion

In the formulas below, / means to divide, * means to multiply, - means subtract, + means to add and = is equal. Tc = temperature in degrees Celsius, Tf = temperature in degrees Fahrenheit.
To convert a Fahrenheit temperature into Celsius: Tc = (5/9)*(Tf-32)
To convert a Celsius temperature into degrees Fahrenheit: Tf = ((9/5)*Tc)+32

to C	C or F	to F	to C	C or F	to F	to C	C or F	to F	to C	C or F	to F
-28.89	-20	-4	-6.67	20	68	15.56	60	140	37.78	100	212
-28.33	-19	-2.2	-6.11	21	69.8	16.11	61	141.8	38.33	101	213.8
-27.78	-18	-0.4	-5.56	22	71.6	16.67	62	143.6	38.89	102	215.6
-27.22	-17	1.4	-5	23	73.4	17.22	63	145.4	39.44	103	217.4
-26.67	-16	3.2	-4.44	24	75.2	17.78	64	147.2	40	104	219.2
-26.11	-15	5	-3.89	25	77	18.33	65	149	40.56	105	221
-25.56	-14	6.8	-3.33	26	78.8	18.89	66	150.8	41.11	106	222.8
-25	-13	8.6	-2.78	27	80.6	19.44	67	152.6	41.67	107	224.6
-24.44	-12	10.4	-2.22	28	82.4	20	68	154.4	42.22	108	226.4
-23.89	-11	12.2	-1.67	29	84.2	20.56	69	156.2	42.78	109	228.2
-23.33	-10	14	-1.11	30	86	21.11	70	158	43.33	110	230
-22.78	-9	15.8	-0.56	31	87.8	21.67	71	159.8	43.89	111	231.8
-22.22	-8	17.6	0	32	89.6	22.22	72	161.6	44.44	112	233.6
-21.67	-7	19.4	0.56	33	91.4	22.78	73	163.4	45	113	235.4
-21.11	-6	21.2	1.11	34	93.2	23.33	74	165.2	45.56	114	237.2
-20.56	-5	23	1.67	35	95	23.89	75	167	46.11	115	239
-20	-4	24.8	2.22	36	96.8	24.44	76	168.8	46.67	116	240.8
-19.44	-3	26.6	2.78	37	98.6	25	77	170.6	47.22	117	242.6
-18.89	-2	28.4	3.33	38	100.4	25.56	78	172.4	47.78	118	244.4
-18.33	-1	30.2	3.89	39	102.2	26.11	79	174.2	48.33	119	246.2
-17.78	0	32	4.44	40	104	26.67	80	176	48.89	120	248
-17.22	1	33.8	5	41	105.8	27.22	81	177.8	49.44	121	249.8
-16.67	2	35.6	5.56	42	107.6	27.78	82	179.6	50	122	251.6
-16.11	3	37.4	6.11	43	109.4	28.33	83	181.4	50.56	123	253.4
-15.56	4	39.2	6.67	44	111.2	28.89	84	183.2	51.11	124	255.2
-15	5	41	7.22	45	113	29.44	85	185	51.67	125	257
-14.44	6	42.8	7.78	46	114.8	30	86	186.8	52.22	126	258.8
-13.89	7	44.6	8.33	47	116.6	30.56	87	188.6	52.78	127	260.6
-13.33	8	46.4	8.89	48	118.4	31.11	88	190.4	53.33	128	262.4
-12.78	9	48.2	9.44	49	120.2	31.67	89	192.2	53.89	129	264.2
-12.22	10	50	10	50	122	32.22	90	194	54.44	130	266
-11.67	11	51.8	10.56	51	123.8	32.78	91	195.8	55	131	267.8
-11.11	12	53.6	11.11	52	125.6	33.33	92	197.6	55.56	132	269.6
-10.56	13	55.4	11.67	53	127.4	33.89	93	199.4	56.11	133	271.4
-10	14	57.2	12.22	54	129.2	34.44	94	201.2	56.67	134	273.2
-9.44	15	59	12.78	55	131	35	95	203	57.22	135	275
-8.89	16	60.8	13.33	56	132.8	35.56	96	204.8	57.78	136	276.8
-8.33	17	62.6	13.89	57	134.6	36.11	97	206.6	58.33	137	278.6
-7.78	18	64.4	14.44	58	136.4	36.67	98	208.4	58.89	138	280.4
-7.22	19	66.2	15	59	138.2	37.22	99	210.2	59.44	139	282.2

Wind Speed Conversion

1 mph = 0.87 knots per hour; 1 knot = 1.15 mph

to Kt	Kt or mph	to mph	to Kt	Kt or mph	to mph	to Kt	Kt or mph	to mph	to Kt	Kt or mph	to mph
1	1	1	23	26	30	44	51	59	66	76	87
2	2	2	23	27	31	45	52	60	67	77	89
3	3	3	24	28	32	46	53	61	68	78	90
3	4	5	25	29	33	47	54	62	69	79	91
4	5	6	26	30	35	48	55	63	70	80	92
5	6	7	27	31	36	49	56	64	70	81	93
6	7	8	28	32	37	50	57	66	71	82	94
7	8	9	29	33	38	50	58	67	72	83	96
8	9	10	30	34	39	51	59	68	73	84	97
9	10	12	30	35	40	52	60	69	74	85	98
10	11	13	31	36	41	53	61	70	75	86	99
10	12	14	32	37	43	54	62	71	76	87	100
11	13	15	33	38	44	55	63	72	76	88	101
12	14	16	34	39	45	56	64	74	77	89	102
13	15	17	35	40	46	56	65	75	78	90	104
14	16	18	36	41	47	57	66	76	79	91	105
15	17	20	36	42	48	58	67	77	80	92	106
16	18	21	37	43	49	59	68	78	81	93	107
17	19	22	38	44	51	60	69	79	82	94	108
17	20	23	39	45	52	61	70	81	83	95	109
18	21	24	40	46	53	62	71	82	83	96	110
19	22	25	41	47	54	63	72	83	84	97	112
20	23	26	42	48	55	63	73	84	85	98	113
21	24	28	43	49	56	64	74	85	86	99	114
22	25	29	43	50	58	65	75	86	87	100	115

Beaufort Wind Scale

This scale is used to estimate wind speeds when no wind equipment is available.

Speed (mph)	Description - Visible Condition
0	Calm: Smoke rises vertically
1 - 4	Light air: Direction of wind shown by smoke but not by wind vanes
4 - 7	Light breeze: Felt on face; leaves rustle; ordinary wind vane moved by wind
8 - 12	Gentle breeze: Leaves and small twigs in constant motion; wind extends light flag
13 - 18	Moderate breeze: Raises dust and loose paper; small branches are moved
19 - 24	Fresh breeze: Small trees in leaf begin to sway; crested wavelets form on inland water
25 - 31	Strong breeze: Large branches in motion; telephone wires whistle; umbrellas used with difficulty
32 - 38	Moderate gale: Whole trees in motion; inconvenience in walking against wind
39 - 46	Fresh gale: Breaks twigs off trees; generally impedes progress
47 - 54	Strong gale: Slight structural damage occurs; chimney pots and slates removed
55 - 63	Whole gale: Trees uprooted; considerable structural damage occurs
64 - 72	Storm: Very rarely experienced; accompanied by widespread damage
73+	Hurricane: Devastation occurs

Pressure Conversion

Standard Atmosphere conversion:
29.92 inches of mercury (Hg) = 1013.25 millibars

inches	millibars	inches	millibars	inches	millibars	inches	millibars	inches	millibars
28.50	965.1	29.00	982.1	29.50	999.0	30.00	1015.9	30.50	1032.8
28.51	965.5	29.01	982.4	29.51	999.3	30.01	1016.3	30.51	1033.2
28.52	965.8	29.02	982.7	29.52	999.7	30.02	1016.6	30.52	1033.5
28.53	966.1	29.03	983.1	29.53	1000.0	30.03	1016.9	30.53	1033.9
28.54	966.5	29.04	983.4	29.54	1000.3	30.04	1017.3	30.54	1034.2
28.55	966.8	29.05	983.7	29.55	1000.7	30.05	1017.6	30.55	1034.5
28.56	967.2	29.06	984.1	29.56	1001.0	30.06	1017.9	30.56	1034.9
28.57	967.5	29.07	984.4	29.57	1001.4	30.07	1018.3	30.57	1035.2
28.58	967.8	29.08	984.8	29.58	1001.7	30.08	1018.6	30.58	1035.6
28.59	968.2	29.09	985.1	29.59	1002.0	30.09	1019.0	30.59	1035.9
28.60	968.5	29.10	985.4	29.60	1002.4	30.10	1019.3	30.60	1036.2
28.61	968.8	29.11	985.8	29.61	1002.7	30.11	1019.6	30.61	1036.6
28.62	969.2	29.12	986.1	29.62	1003.0	30.12	1020.0	30.62	1036.9
28.63	969.5	29.13	986.5	29.63	1003.4	30.13	1020.3	30.63	1037.3
28.64	969.9	29.14	986.8	29.64	1003.7	30.14	1020.7	30.64	1037.6
28.65	970.2	29.15	987.1	29.65	1004.1	30.15	1021.0	30.65	1037.9
28.66	970.5	29.16	987.5	29.66	1004.4	30.16	1021.3	30.66	1038.3
28.67	970.9	29.17	987.8	29.67	1004.7	30.17	1021.7	30.67	1038.6
28.68	971.2	29.18	988.1	29.68	1005.1	30.18	1022.0	30.68	1038.9
28.69	971.6	29.19	988.5	29.69	1005.4	30.19	1022.4	30.69	1039.3
28.70	971.9	29.20	988.8	29.70	1005.8	30.20	1022.7	30.70	1039.6
28.71	972.2	29.21	989.2	29.71	1006.1	30.21	1023.0	30.71	1040.0
28.72	972.6	29.22	989.5	29.72	1006.4	30.22	1023.4	30.72	1040.3
28.73	972.9	29.23	989.8	29.73	1006.8	30.23	1023.7	30.73	1040.6
28.74	973.2	29.24	990.2	29.74	1007.1	30.24	1024.0	30.74	1041.0
28.75	973.6	29.25	990.5	29.75	1007.5	30.25	1024.4	30.75	1041.3
28.76	973.9	29.26	990.8	29.76	1007.8	30.26	1024.7	30.76	1041.6
28.77	974.3	29.27	991.2	29.77	1008.1	30.27	1025.1	30.77	1042.0
28.78	974.6	29.28	991.5	29.78	1008.5	30.28	1025.4	30.78	1042.3
28.79	974.9	29.29	991.9	29.79	1008.8	30.29	1025.7	30.79	1042.7
28.80	975.3	29.30	992.2	29.80	1009.1	30.30	1026.1	30.80	1043.0
28.81	975.6	29.31	992.6	29.81	1009.5	30.31	1026.4	30.81	1043.3
28.82	976.0	29.32	992.9	29.82	1009.8	30.32	1026.8	30.82	1043.7
28.83	976.3	29.33	993.2	29.83	1010.2	30.33	1027.1	30.83	1044.0
28.84	976.6	29.34	992.6	29.84	1010.5	30.34	1027.4	30.84	1044.4
28.85	977.0	29.35	993.9	29.85	1010.8	30.35	1027.8	30.85	1044.7
28.86	977.3	29.36	994.2	29.86	1011.2	30.36	1028.1	30.86	1045.0
28.87	977.7	29.37	994.6	29.87	1011.5	30.37	1028.4	30.87	1045.4
28.88	978.0	29.38	994.9	29.88	1011.9	30.38	1028.8	30.88	1045.7
28.89	978.3	29.39	995.3	29.89	1012.2	30.39	1029.1	30.89	1046.1
28.90	978.7	29.40	995.6	29.90	1012.5	30.40	1029.5	30.90	1046.4
28.91	979.0	29.41	995.9	29.91	1012.9	30.41	1029.8	30.91	1046.7
28.92	979.3	29.42	996.3	29.92	1013.2	30.42	1030.1	30.92	1047.1
28.93	979.7	29.43	996.6	29.93	1013.5	30.43	1030.5	30.93	1047.4
28.94	980.0	29.44	997.0	29.94	1013.9	30.44	1030.8	30.94	1047.7
28.95	980.4	29.45	997.3	29.95	1014.2	30.45	1031.2	30.95	1048.1
28.96	980.7	29.46	997.6	29.96	1014.6	30.46	1031.5	30.96	1048.4
28.97	981.0	29.47	998.0	29.97	1014.9	30.47	1031.8	30.97	1048.8
28.98	981.4	29.48	998.3	29.98	1015.2	30.48	1032.2	30.98	1049.1
28.99	981.7	29.49	998.6	29.99	1015.6	30.49	1032.5	30.99	1049.4

Sunrise/Sunset Table for San Diego

Sunrise and Sunset Tables have been computed for any location by the U.S. Naval Observatory. Click on: **aa.usno.navy.mil/data/docs/RS_OneYear.html**

The chart shows the times of sunrise and sunset for Any Year in Pacific Standard Time. Add one hour for daylight time (between the first Sunday in April and the last Sunday in October at 2 am).

	JAN	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
	Rise Set	Rise Set	Rise Set	Rise Set	Rise Set	Rise Set	Rise Set	Rise Set	Rise Set	Rise Set	Rise Set	Rise Set
1	0651 1653	0644 1721	0617 1746	0537 1809	0502 1830	0442 1851	0444 1901	0502 1847	0523 1814	0543 1733	0606 1658	0633 1642
2	0651 1654	0643 1722	0615 1746	0536 1809	0501 1831	0441 1852	0445 1900	0503 1846	0524 1812	0543 1732	0607 1657	0634 1642
3	0651 1655	0642 1723	0614 1747	0534 1810	0500 1832	0441 1853	0445 1900	0504 1845	0524 1811	0544 1731	0608 1656	0634 1642
4	0651 1656	0641 1724	0613 1748	0533 1811	0459 1832	0441 1853	0445 1900	0504 1845	0525 1810	0545 1730	0609 1655	0635 1642
5	0652 1657	0641 1725	0612 1749	0532 1811	0458 1833	0441 1854	0446 1900	0505 1844	0526 1808	0545 1728	0610 1654	0636 1642
6	0652 1657	0640 1726	0611 1750	0530 1812	0457 1834	0440 1854	0446 1900	0506 1843	0526 1807	0546 1727	0610 1654	0637 1642
7	0652 1658	0639 1727	0609 1750	0529 1813	0456 1835	0440 1855	0447 1900	0506 1842	0527 1806	0547 1726	0611 1653	0638 1642
8	0652 1659	0638 1728	0608 1751	0528 1813	0455 1835	0440 1855	0447 1900	0507 1841	0528 1804	0547 1724	0612 1652	0638 1642
9	0652 1700	0637 1729	0607 1752	0527 1814	0454 1836	0440 1856	0448 1859	0508 1840	0528 1803	0548 1723	0613 1651	0639 1643
10	0652 1701	0637 1729	0606 1753	0525 1815	0454 1837	0440 1856	0448 1859	0508 1839	0529 1802	0549 1722	0614 1651	0640 1643
11	0652 1702	0636 1730	0604 1753	0524 1816	0453 1837	0440 1856	0449 1859	0509 1838	0530 1800	0550 1721	0615 1650	0641 1643
12	0652 1702	0635 1731	0603 1754	0523 1816	0452 1838	0440 1857	0450 1859	0510 1837	0530 1759	0550 1719	0616 1649	0641 1643
13	0651 1703	0634 1732	0602 1755	0522 1817	0451 1839	0440 1857	0450 1858	0510 1836	0531 1758	0551 1718	0617 1649	0642 1643
14	0651 1704	0633 1733	0600 1756	0521 1818	0451 1840	0440 1858	0451 1858	0511 1835	0531 1756	0552 1717	0618 1648	0643 1644
15	0651 1705	0632 1734	0559 1756	0519 1818	0450 1840	0440 1858	0451 1857	0512 1834	0532 1755	0552 1716	0618 1648	0643 1644
16	0651 1706	0631 1735	0558 1757	0518 1819	0449 1841	0440 1858	0452 1857	0513 1833	0533 1754	0553 1715	0619 1647	0644 1644
17	0651 1707	0630 1736	0557 1758	0517 1820	0449 1842	0440 1859	0452 1857	0513 1832	0533 1752	0554 1713	0620 1646	0645 1645
18	0650 1708	0629 1737	0555 1759	0516 1821	0448 1842	0440 1859	0453 1856	0514 1830	0534 1751	0555 1712	0621 1646	0645 1645

19	0650 1709	0628 1737	0554 1759	0515 1821	0447 1843	0441 1859	0454 1856	0515 1829	0535 1750	0555 1711	0622 1646	0646 1646
20	0650 1710	0627 1738	0553 1800	0513 1822	0447 1844	0441 1859	0454 1855	0515 1828	0535 1748	0556 1710	0623 1645	0646 1646
21	0649 1711	0626 1739	0551 1801	0512 1823	0446 1844	0441 1900	0455 1855	0516 1827	0536 1747	0557 1709	0624 1645	0647 1646
22	0649 1712	0625 1740	0550 1801	0511 1823	0446 1845	0441 1900	0456 1854	0517 1826	0537 1746	0558 1708	0625 1644	0647 1647
23	0649 1713	0624 1741	0549 1802	0510 1824	0445 1846	0441 1900	0456 1853	0517 1825	0537 1744	0559 1707	0626 1644	0648 1647
24	0648 1714	0622 1742	0547 1803	0509 1825	0445 1847	0442 1900	0457 1853	0518 1823	0538 1743	0559 1706	0627 1644	0648 1648
25	0648 1714	0621 1742	0546 1804	0508 1826	0444 1847	0442 1900	0458 1852	0519 1822	0539 1741	0600 1705	0627 1643	0649 1649
26	0647 1715	0620 1743	0545 1804	0507 1826	0444 1848	0442 1900	0458 1852	0519 1821	0539 1740	0601 1704	0628 1643	0649 1649
27	0647 1716	0619 1744	0543 1805	0506 1827	0443 1848	0443 1900	0459 1851	0520 1820	0540 1739	0602 1703	0629 1643	0649 1650
28	0646 1717	0618 1745	0542 1806	0505 1828	0443 1849	0443 1901	0500 1850	0520 1819	0541 1737	0603 1702	0630 1643	0650 1650
29	0645 1718		0541 1806	0504 1829	0443 1850	0443 1901	0500 1849	0521 1817	0541 1736	0604 1701	0631 1643	0650 1651
30	0645 1719		0540 1807	0503 1829	0442 1850	0444 1901	0501 1849	0522 1816	0542 1735	0604 1700	0632 1642	0650 1652
31	0644 1720		0538 1808		0442 1851		0502 1848	0522 1815		0605 1659		0651 1653

Tide Table for San Diego

The tide predictions for San Diego below are taken from the National Ocean Service's web site:
co-ops.nos.noaa.gov/tides03/get_pred.shtml?stn=1812+San+Diego
Other stations in Southern California and Baja California can be found at:
co-ops.nos.noaa.gov/tides03/tab2wc1a.html#122

San Diego 2003 Water Level Predictions

All times listed are in Local Time (daylight and standard time accounted for), and all heights are in Feet referenced to Mean Lower Low Water (MLLW).

Date	Time / Height	Time / Height	Time / Height	Time / Height
1/1/2003	1:16am L 1.9	7:36am H 7.3	2:52pm L -1.7	9:22pm H 4.2
1/2/2003	2:02am L 2.0	8:19am H 7.4	3:35pm L -1.8	10:06pm H 4.3
1/3/2003	2:45am L 2.0	9:00am H 7.2	4:16pm L -1.6	10:49pm H 4.2
1/4/2003	3:28am L 2.1	9:40am H 6.9	4:56pm L -1.3	11:32pm H 4.2
1/5/2003	4:11am L 2.3	10:20am H 6.4	5:35pm L -0.9	
1/6/2003	12:15am H 4.1	4:58am L 2.4	10:59am H 5.8	6:13pm L -0.4
1/7/2003	1:00am H 4.1	5:51am L 2.6	11:40am H 5.1	6:51pm L 0.2
1/8/2003	1:48am H 4.2	6:59am L 2.7	12:28pm H 4.4	7:30pm L 0.7
1/9/2003	2:37am H 4.3	8:29am L 2.6	1:33pm H 3.7	8:13pm L 1.3
1/10/2003	3:27am H 4.5	10:11am L 2.2	3:13pm H 3.1	9:02pm L 1.7
1/11/2003	4:14am H 4.8	11:30am L 1.6	5:08pm H 3.0	9:58pm L 2.1
1/12/2003	4:58am H 5.1	12:24pm L 1.0	6:33pm H 3.1	10:55pm L 2.3
1/13/2003	5:38am H 5.4	1:05pm L 0.4	7:30pm H 3.4	11:46pm L 2.4
1/14/2003	6:17am H 5.8	1:41pm L -0.2	8:11pm H 3.6	
1/15/2003	12:31am L 2.4	6:53am H 6.2	2:15pm L -0.6	8:46pm H 3.8
1/16/2003	1:11am L 2.3	7:29am H 6.5	2:48pm L -1.0	9:18pm H 3.9
1/17/2003	1:48am L 2.2	8:05am H 6.7	3:21pm L -1.2	9:50pm H 4.0
1/18/2003	2:26am L 2.1	8:42am H 6.9	3:55pm L -1.4	10:23pm H 4.1
1/19/2003	3:06am L 2.0	9:19am H 6.9	4:30pm L -1.3	10:57pm H 4.3
1/20/2003	3:49am L 1.9	9:59am H 6.7	5:05pm L -1.1	11:34pm H 4.4
1/21/2003	4:37am L 1.8	10:42am H 6.2	5:42pm L -0.7	
1/22/2003	12:14am H 4.6	5:35am L 1.8	11:31am H 5.5	6:21pm L -0.2
1/23/2003	12:59am H 4.8	6:46am L 1.8	12:31pm H 4.6	7:04pm L 0.5
1/24/2003	1:51am H 5.0	8:15am L 1.6	1:52pm H 3.8	7:53pm L 1.1
1/25/2003	2:49am H 5.3	9:55am L 1.1	3:46pm H 3.2	8:55pm L 1.7

1/26/2003	3:53am H 5.7	11:22am L 0.4	5:41pm H 3.3	10:11pm L 2.1
1/27/2003	4:56am H 6.0	12:28pm L -0.4	7:01pm H 3.6	11:25pm L 2.3
1/28/2003	5:54am H 6.4	1:20pm L -1.0	7:56pm H 3.9	
1/29/2003	12:27am L 2.2	6:46am H 6.7	2:05pm L -1.4	8:38pm H 4.2
1/30/2003	1:19am L 2.0	7:32am H 6.9	2:45pm L -1.6	9:15pm H 4.3
1/31/2003	2:04am L 1.9	8:14am H 7.0	3:22pm L -1.6	9:49pm H 4.4
2/1/2003	2:45am L 1.7	8:53am H 6.8	3:55pm L -1.4	10:20pm H 4.5
2/2/2003	3:23am L 1.6	9:29am H 6.6	4:27pm L -1.1	10:51pm H 4.5
2/3/2003	4:01am L 1.6	10:03am H 6.1	4:56pm L -0.7	11:20pm H 4.5
2/4/2003	4:39am L 1.7	10:37am H 5.6	5:23pm L -0.1	11:50pm H 4.5
2/5/2003	5:20am L 1.8	11:11am H 4.9	5:49pm L 0.4	
2/6/2003	12:21am H 4.5	6:08am L 1.9	11:49am H 4.2	6:14pm L 1.0
2/7/2003	12:55am H 4.5	7:11am L 2.0	12:37pm H 3.5	6:38pm L 1.6
2/8/2003	1:37am H 4.5	8:43am L 1.9	2:02pm H 2.8	7:06pm L 2.1
2/9/2003	2:34am H 4.5	10:38am L 1.6	5:09pm H 2.6	7:53pm L 2.5
2/10/2003	3:45am H 4.7	11:56am L 1.0	7:03pm H 3.0	9:52pm L 2.8
2/11/2003	4:52am H 5.0	12:43pm L 0.4	7:37pm H 3.3	11:22pm L 2.8
2/12/2003	5:47am H 5.4	1:20pm L -0.2	8:03pm H 3.6	
2/13/2003	12:19am L 2.5	6:33am H 5.9	1:53pm L -0.7	8:27pm H 3.9
2/14/2003	1:03am L 2.2	7:14am H 6.3	2:25pm L -1.1	8:52pm H 4.2
2/15/2003	1:43am L 1.8	7:53am H 6.7	2:57pm L -1.4	9:19pm H 4.4
2/16/2003	2:22am L 1.5	8:32am H 6.9	3:28pm L -1.5	9:47pm H 4.7
2/17/2003	3:03am L 1.1	9:12am H 6.8	4:00pm L -1.3	10:18pm H 5.0
2/18/2003	3:47am L 0.9	9:54am H 6.5	4:33pm L -1.0	10:51pm H 5.2
2/19/2003	4:35am L 0.7	10:38am H 5.9	5:06pm L -0.4	11:27pm H 5.4
2/20/2003	5:29am L 0.7	11:29am H 5.1	5:41pm L 0.3	
2/21/2003	12:07am H 5.5	6:34am L 0.7	12:30pm H 4.1	6:18pm L 1.0
2/22/2003	12:56am H 5.5	7:56am L 0.7	1:58pm H 3.3	7:04pm L 1.8
2/23/2003	1:57am H 5.4	9:38am L 0.5	4:16pm H 3.0	8:15pm L 2.4
2/24/2003	3:16am H 5.4	11:12am L 0.0	6:14pm H 3.3	10:05pm L 2.7
2/25/2003	4:38am H 5.6	12:20pm L -0.5	7:13pm H 3.8	11:36pm L 2.5

2/26/2003	5:47am H 5.9	1:10pm L -1.0	7:51pm H 4.1	
2/27/2003	12:38am L 2.2	6:42am H 6.2	1:51pm L -1.2	8:23pm H 4.4
2/28/2003	1:25am L 1.8	7:28am H 6.4	2:26pm L -1.3	8:51pm H 4.6
3/1/2003	2:04am L 1.4	8:07am H 6.4	2:57pm L -1.2	9:17pm H 4.8
3/2/2003	2:40am L 1.2	8:42am H 6.3	3:25pm L -0.9	9:42pm H 4.9
3/3/2003	3:13am L 1.0	9:15am H 6.0	3:49pm L -0.6	10:05pm H 5.0
3/4/2003	3:46am L 0.9	9:46am H 5.6	4:12pm L -0.2	10:27pm H 5.0
3/5/2003	4:19am L 0.9	10:18am H 5.1	4:33pm L 0.3	10:49pm H 5.0
3/6/2003	4:54am L 0.9	10:50am H 4.5	4:52pm L 0.8	11:12pm H 4.9
3/7/2003	5:33am L 1.0	11:26am H 3.9	5:10pm L 1.3	11:37pm H 4.8
3/8/2003	6:22am L 1.2	12:11pm H 3.2	5:24pm L 1.8	
3/9/2003	12:08am H 4.7	7:32am L 1.4	1:29pm H 2.7	5:28pm L 2.3
3/10/2003	12:54am H 4.5	9:25am L 1.3		
3/11/2003	2:14am H 4.4	11:08am L 0.9		
3/12/2003	3:58am H 4.6	12:05pm L 0.3	7:20pm H 3.4	11:08pm L 2.9
3/13/2003	5:13am H 5.0	12:45pm L -0.2	7:32pm H 3.8	
3/14/2003	12:07am L 2.4	6:08am H 5.5	1:18pm L -0.7	7:51pm H 4.2
3/15/2003	12:51am L 1.9	6:54am H 6.0	1:50pm L -1.1	8:13pm H 4.6
3/16/2003	1:32am L 1.2	7:37am H 6.4	2:22pm L -1.2	8:39pm H 5.0
3/17/2003	2:13am L 0.6	8:19am H 6.5	2:53pm L -1.2	9:06pm H 5.4
3/18/2003	2:55am L 0.1	9:02am H 6.3	3:25pm L -0.9	9:37pm H 5.8
3/19/2003	3:40am L -0.3	9:47am H 5.9	3:57pm L -0.4	10:09pm H 6.1
3/20/2003	4:28am L -0.5	10:36am H 5.3	4:30pm L 0.3	10:45pm H 6.1
3/21/2003	5:21am L -0.5	11:31am H 4.5	5:04pm L 1.0	11:25pm H 6.0
3/22/2003	6:24am L -0.3	12:40pm H 3.7	5:41pm L 1.7	
3/23/2003	12:13am H 5.8	7:43am L -0.1	2:24pm H 3.1	6:29pm L 2.4
3/24/2003	1:18am H 5.4	9:20am L 0.0	4:49pm H 3.2	8:07pm L 2.9
3/25/2003	2:48am H 5.1	10:51am L -0.2	6:11pm H 3.6	10:23pm L 2.9
3/26/2003	4:23am H 5.1	11:56am L -0.5	6:53pm H 4.1	11:46pm L 2.4
3/27/2003	5:37am H 5.3	12:44pm L -0.7	7:25pm H 4.5	
3/28/2003	12:40am L 1.9	6:32am H 5.5	1:22pm L -0.8	7:52pm H 4.7

3/29/2003	1:21am L 1.4	7:16am H 5.6	1:54pm L -0.7	8:16pm H 5.0
3/30/2003	1:57am L 0.9	7:54am H 5.6	2:21pm L -0.5	8:38pm H 5.2
3/31/2003	2:29am L 0.6	8:28am H 5.4	2:45pm L -0.2	8:59pm H 5.3
4/1/2003	3:00am L 0.4	9:00am H 5.2	3:07pm L 0.1	9:18pm H 5.4
4/2/2003	3:30am L 0.2	9:32am H 4.9	3:27pm L 0.5	9:38pm H 5.5
4/3/2003	4:01am L 0.1	10:04am H 4.4	3:45pm L 0.9	9:58pm H 5.4
4/4/2003	4:34am L 0.2	10:39am H 4.0	4:03pm L 1.4	10:19pm H 5.4
4/5/2003	5:11am L 0.3	11:18am H 3.5	4:18pm L 1.8	10:43pm H 5.2
Daylight Savings Time Begins 4/6/2003 02:00				
4/6/2003	6:55am L 0.5	1:09pm H 3.0	5:30pm L 2.2	
4/7/2003	12:12am H 5.0	7:56am L 0.7	2:45pm H 2.6	5:26pm L 2.5
4/8/2003	12:53am H 4.7	9:26am L 0.8		
4/9/2003	2:05am H 4.5	11:03am L 0.6		
4/10/2003	3:59am H 4.4	12:09pm L 0.2	7:30pm H 3.7	11:48pm L 2.9
4/11/2003	5:32am H 4.7	12:54pm L -0.2	7:43pm H 4.1	
4/12/2003	12:48am L 2.2	6:37am H 5.1	1:32pm L -0.5	8:04pm H 4.6
4/13/2003	1:35am L 1.4	7:30am H 5.5	2:06pm L -0.7	8:28pm H 5.2
4/14/2003	2:18am L 0.6	8:19am H 5.7	2:40pm L -0.7	8:56pm H 5.7
4/15/2003	3:01am L -0.2	9:06am H 5.7	3:13pm L -0.4	9:26pm H 6.2
4/16/2003	3:46am L -0.9	9:55am H 5.5	3:47pm L -0.1	9:59pm H 6.6
4/17/2003	4:32am L -1.3	10:44am H 5.1	4:21pm L 0.4	10:34pm H 6.8
4/18/2003	5:21am L -1.4	11:38am H 4.6	4:56pm L 1.0	11:12pm H 6.7
4/19/2003	6:15am L -1.3	12:39pm H 4.0	5:34pm L 1.7	11:55pm H 6.4
4/20/2003	7:16am L -1.0	1:56pm H 3.5	6:17pm L 2.3	
4/21/2003	12:45am H 5.9	8:29am L -0.6	3:42pm H 3.3	7:21pm L 2.8
4/22/2003	1:51am H 5.3	9:54am L -0.4	5:32pm H 3.6	9:22pm L 3.1
4/23/2003	3:22am H 4.9	11:14am L -0.3	6:35pm H 4.0	11:23pm L 2.8
4/24/2003	4:58am H 4.7	12:16pm L -0.3	7:14pm H 4.4	
4/25/2003	12:38am L 2.2	6:13am H 4.7	1:03pm L -0.3	7:45pm H 4.8
4/26/2003	1:28am L 1.6	7:11am H 4.8	1:40pm L -0.2	8:11pm H 5.1
4/27/2003	2:09am L 1.0	7:57am H 4.8	2:11pm L 0.0	8:34pm H 5.3

4/28/2003	2:43am L 0.6	8:37am H 4.7	2:37pm L 0.3	8:55pm H 5.6
4/29/2003	3:15am L 0.2	9:14am H 4.6	3:01pm L 0.6	9:15pm H 5.7
4/30/2003	3:46am L -0.1	9:49am H 4.4	3:22pm L 0.9	9:35pm H 5.8

5/1/2003	4:16am L -0.3	10:24am H 4.2	3:43pm L 1.3	9:56pm H 5.9
5/2/2003	4:48am L -0.4	11:00am H 3.9	4:03pm L 1.6	10:18pm H 5.8
5/3/2003	5:21am L -0.4	11:39am H 3.6	4:23pm L 1.9	10:43pm H 5.7
5/4/2003	5:59am L -0.2	12:25pm H 3.3	4:42pm L 2.2	11:10pm H 5.6
5/5/2003	6:43am L -0.1	1:26pm H 3.0	5:00pm L 2.5	11:43pm H 5.3
5/6/2003	7:39am L 0.1	3:05pm H 2.9	5:19pm L 2.8	
5/7/2003	12:28am H 5.0	8:47am L 0.2		
5/8/2003	1:35am H 4.7	10:01am L 0.2	5:59pm H 3.5	9:26pm L 3.2
5/9/2003	3:12am H 4.5	11:04am L 0.1	6:21pm H 4.0	11:19pm L 2.7
5/10/2003	4:48am H 4.5	11:55am L 0.0	6:46pm H 4.5	
5/11/2003	12:25am L 1.9	6:04am H 4.6	12:38pm L -0.1	7:14pm H 5.2
5/12/2003	1:17am L 1.0	7:08am H 4.8	1:18pm L 0.0	7:43pm H 5.8
5/13/2003	2:05am L 0.0	8:05am H 4.9	1:56pm L 0.2	8:16pm H 6.4
5/14/2003	2:51am L -0.8	8:59am H 4.9	2:34pm L 0.5	8:50pm H 6.9
5/15/2003	3:38am L -1.5	9:53am H 4.7	3:12pm L 0.9	9:27pm H 7.2
5/16/2003	4:26am L -1.8	10:47am H 4.5	3:51pm L 1.3	10:07pm H 7.3
5/17/2003	5:16am L -1.9	11:44am H 4.2	4:31pm L 1.7	10:49pm H 7.1
5/18/2003	6:09am L -1.7	12:47pm H 3.9	5:16pm L 2.2	11:35pm H 6.6
5/19/2003	7:07am L -1.3	2:00pm H 3.7	6:09pm L 2.6	
5/20/2003	12:27am H 6.0	8:10am L -0.9	3:23pm H 3.7	7:24pm L 2.9
5/21/2003	1:30am H 5.4	9:17am L -0.5	4:42pm H 3.9	9:10pm L 3.0
5/22/2003	2:48am H 4.8	10:23am L -0.2	5:40pm H 4.3	10:56pm L 2.7
5/23/2003	4:15am H 4.3	11:20am L 0.1	6:22pm H 4.7	
5/24/2003	12:13am L 2.1	5:35am H 4.1	12:07pm L 0.3	6:55pm H 5.0
5/25/2003	1:07am L 1.5	6:41am H 4.1	12:46pm L 0.6	7:23pm H 5.3
5/26/2003	1:50am L 0.9	7:35am H 4.0	1:19pm L 0.9	7:48pm H 5.6
5/27/2003	2:27am L 0.4	8:22am H 4.0	1:49pm L 1.2	8:12pm H 5.8

5/28/2003	3:01am L 0.0	9:05am H 3.9	2:16pm L 1.5	8:36pm H 6.0
5/29/2003	3:33am L -0.3	9:45am H 3.9	2:42pm L 1.7	9:00pm H 6.1
5/30/2003	4:05am L -0.5	10:24am H 3.8	3:07pm L 1.9	9:26pm H 6.2
5/31/2003	4:39am L -0.6	11:04am H 3.6	3:33pm L 2.1	9:53pm H 6.2
6/1/2003	5:14am L -0.6	11:46am H 3.5	3:59pm L 2.4	10:23pm H 6.1
6/2/2003	5:52am L -0.6	12:33pm H 3.4	4:29pm L 2.6	10:56pm H 6.0
6/3/2003	6:34am L -0.5	1:28pm H 3.3	5:04pm L 2.8	11:34pm H 5.7
6/4/2003	7:21am L -0.3	2:31pm H 3.4	5:56pm L 3.0	
6/5/2003	12:20am H 5.4	8:12am L -0.2	3:35pm H 3.6	7:19pm L 3.1
6/6/2003	1:20am H 5.0	9:07am L 0.0	4:27pm H 4.0	9:09pm L 3.0
6/7/2003	2:40am H 4.6	10:02am L 0.2	5:10pm H 4.5	10:49pm L 2.4
6/8/2003	4:12am H 4.2	10:55am L 0.4	5:48pm H 5.1	
6/9/2003	12:03am L 1.6	5:39am H 4.1	11:44am L 0.6	6:25pm H 5.7
6/10/2003	1:03am L 0.6	6:55am H 4.1	12:32pm L 0.9	7:03pm H 6.4
6/11/2003	1:56am L -0.4	8:01am H 4.2	1:17pm L 1.2	7:43pm H 6.9
6/12/2003	2:45am L -1.1	9:01am H 4.3	2:02pm L 1.4	8:24pm H 7.3
6/13/2003	3:34am L -1.7	9:57am H 4.3	2:47pm L 1.7	9:07pm H 7.5
6/14/2003	4:22am L -1.9	10:51am H 4.2	3:32pm L 1.9	9:51pm H 7.5
6/15/2003	5:10am L -1.9	11:45am H 4.2	4:19pm L 2.1	10:36pm H 7.2
6/16/2003	5:59am L -1.7	12:40pm H 4.1	5:08pm L 2.4	11:23pm H 6.8
6/17/2003	6:48am L -1.3	1:37pm H 4.1	6:04pm L 2.6	
6/18/2003	12:11am H 6.2	7:39am L -0.8	2:37pm H 4.1	7:11pm L 2.8
6/19/2003	1:04am H 5.5	8:30am L -0.3	3:36pm H 4.3	8:34pm L 2.8
6/20/2003	2:06am H 4.7	9:21am L 0.2	4:31pm H 4.5	10:08pm L 2.6
6/21/2003	3:20am H 4.1	10:11am L 0.7	5:17pm H 4.8	11:33pm L 2.2
6/22/2003	4:46am H 3.7	10:59am L 1.1	5:57pm H 5.1	
6/23/2003	12:39am L 1.6	6:08am H 3.5	11:43am L 1.5	6:31pm H 5.4
6/24/2003	1:29am L 1.0	7:19am H 3.5	12:24pm L 1.8	7:02pm H 5.7
6/25/2003	2:10am L 0.5	8:16am H 3.5	1:02pm L 2.0	7:33pm H 5.9
6/26/2003	2:47am L 0.0	9:04am H 3.6	1:38pm L 2.2	8:04pm H 6.2
6/27/2003	3:21am L -0.3	9:46am H 3.7	2:13pm L 2.3	8:35pm H 6.3

6/28/2003	3:55am L -0.6	10:24am H 3.8	2:46pm L 2.4	9:07pm H 6.5
6/29/2003	4:29am L -0.7	11:01am H 3.8	3:20pm L 2.4	9:40pm H 6.5
6/30/2003	5:03am L -0.8	11:38am H 3.8	3:54pm L 2.5	10:14pm H 6.5
7/1/2003	5:39am L -0.8	12:16pm H 3.8	4:32pm L 2.6	10:50pm H 6.4
7/2/2003	6:15am L -0.7	12:57pm H 3.9	5:17pm L 2.6	11:29pm H 6.1
7/3/2003	6:54am L -0.5	1:40pm H 4.0	6:12pm L 2.7	
7/4/2003	12:15am H 5.7	7:34am L -0.2	2:26pm H 4.3	7:22pm L 2.7
7/5/2003	1:09am H 5.1	8:18am L 0.2	3:14pm H 4.6	8:48pm L 2.5
7/6/2003	2:20am H 4.5	9:06am L 0.6	4:03pm H 5.0	10:22pm L 2.0
7/7/2003	3:51am H 3.9	9:58am L 1.1	4:54pm H 5.6	11:46pm L 1.2
7/8/2003	5:31am H 3.7	10:56am L 1.5	5:44pm H 6.1	
7/9/2003	12:54am L 0.3	7:01am H 3.7	11:55am L 1.8	6:33pm H 6.6
7/10/2003	1:52am L -0.5	8:13am H 3.9	12:53pm L 2.0	7:22pm H 7.1
7/11/2003	2:43am L -1.2	9:11am H 4.1	1:47pm L 2.1	8:10pm H 7.4
7/12/2003	3:30am L -1.6	10:01am H 4.3	2:38pm L 2.1	8:57pm H 7.5
7/13/2003	4:15am L -1.7	10:46am H 4.4	3:27pm L 2.1	9:42pm H 7.5
7/14/2003	4:58am L -1.7	11:30am H 4.5	4:14pm L 2.1	10:26pm H 7.2
7/15/2003	5:39am L -1.4	12:12pm H 4.5	5:01pm L 2.2	11:09pm H 6.8
7/16/2003	6:19am L -1.0	12:54pm H 4.5	5:50pm L 2.3	11:52pm H 6.2
7/17/2003	6:57am L -0.4	1:37pm H 4.6	6:44pm L 2.4	
7/18/2003	12:35am H 5.5	7:35am L 0.1	2:21pm H 4.6	7:47pm L 2.5
7/19/2003	1:23am H 4.7	8:12am L 0.8	3:07pm H 4.7	9:04pm L 2.5
7/20/2003	2:23am H 4.0	8:51am L 1.3	3:55pm H 4.8	10:36pm L 2.2
7/21/2003	3:50am H 3.4	9:35am L 1.9	4:44pm H 5.0	
7/22/2003	12:02am L 1.8	5:44am H 3.1	10:29am L 2.3	5:33pm H 5.2
7/23/2003	1:05am L 1.2	7:20am H 3.3	11:30am L 2.6	6:18pm H 5.5
7/24/2003	1:51am L 0.6	8:22am H 3.5	12:28pm L 2.7	7:01pm H 5.8
7/25/2003	2:30am L 0.2	9:05am H 3.7	1:17pm L 2.7	7:41pm H 6.1
7/26/2003	3:05am L -0.2	9:38am H 3.9	1:59pm L 2.6	8:18pm H 6.4
7/27/2003	3:38am L -0.5	10:09am H 4.0	2:38pm L 2.5	8:54pm H 6.7
7/28/2003	4:10am L -0.8	10:38am H 4.2	3:15pm L 2.3	9:29pm H 6.8

7/29/2003	4:41am L -0.9	11:08am H 4.3	3:53pm L 2.2	10:05pm H 6.9
7/30/2003	5:13am L -0.9	11:38am H 4.5	4:33pm L 2.1	10:42pm H 6.7
7/31/2003	5:45am L -0.7	12:11pm H 4.7	5:18pm L 2.0	11:23pm H 6.3
8/1/2003	6:18am L -0.4	12:46pm H 4.8	6:10pm L 1.9	
8/2/2003	12:08am H 5.7	6:53am L 0.1	1:26pm H 5.1	7:12pm L 1.9
8/3/2003	1:02am H 5.0	7:31am L 0.7	2:11pm H 5.3	8:30pm L 1.7
8/4/2003	2:12am H 4.2	8:14am L 1.3	3:04pm H 5.5	10:03pm L 1.4
8/5/2003	3:52am H 3.6	9:09am L 1.9	4:06pm H 5.8	11:36pm L 0.8
8/6/2003	5:53am H 3.4	10:21am L 2.4	5:13pm H 6.1	
8/7/2003	12:50am L 0.1	7:26am H 3.7	11:42am L 2.6	6:17pm H 6.5
8/8/2003	1:48am L -0.6	8:27am H 4.1	12:53pm L 2.6	7:15pm H 6.9
8/9/2003	2:37am L -1.0	9:12am H 4.4	1:52pm L 2.3	8:06pm H 7.2
8/10/2003	3:20am L -1.3	9:50am H 4.6	2:41pm L 2.1	8:53pm H 7.3
8/11/2003	3:59am L -1.3	10:25am H 4.8	3:26pm L 1.9	9:35pm H 7.2
8/12/2003	4:35am L -1.2	10:59am H 4.9	4:08pm L 1.7	10:15pm H 7.0
8/13/2003	5:09am L -0.9	11:30am H 5.0	4:49pm L 1.7	10:52pm H 6.5
8/14/2003	5:39am L -0.4	12:01pm H 5.0	5:30pm L 1.7	11:29pm H 5.9
8/15/2003	6:08am L 0.1	12:32pm H 5.0	6:13pm L 1.8	
8/16/2003	12:06am H 5.2	6:35am L 0.7	1:03pm H 5.0	7:01pm L 1.9
8/17/2003	12:47am H 4.5	7:01am L 1.4	1:37pm H 4.9	8:01pm L 2.0
8/18/2003	1:38am H 3.8	7:26am L 1.9	2:17pm H 4.9	9:25pm L 2.0
8/19/2003	3:04am H 3.2	7:54am L 2.5	3:11pm H 4.9	11:12pm L 1.8
8/20/2003	5:58am H 3.0	8:43am L 2.9	4:23pm H 4.9	
8/21/2003	12:35am L 1.3	7:50am H 3.4	10:43am L 3.2	5:35pm H 5.2
8/22/2003	1:26am L 0.8	8:25am H 3.7	12:14pm L 3.1	6:33pm H 5.5
8/23/2003	2:05am L 0.3	8:49am H 4.0	1:09pm L 2.9	7:20pm H 6.0
8/24/2003	2:38am L -0.2	9:12am H 4.2	1:52pm L 2.6	8:00pm H 6.4
8/25/2003	3:09am L -0.5	9:35am H 4.5	2:30pm L 2.2	8:38pm H 6.7
8/26/2003	3:38am L -0.7	10:00am H 4.8	3:07pm L 1.8	9:15pm H 6.9
8/27/2003	4:08am L -0.8	10:25am H 5.0	3:45pm L 1.5	9:53pm H 6.9

8/28/2003	4:37am L -0.7	10:53am H 5.3	4:26pm L 1.2	10:32pm H 6.6
8/29/2003	5:07am L -0.4	11:23am H 5.6	5:11pm L 1.0	11:15pm H 6.1
8/30/2003	5:39am L 0.1	11:56am H 5.8	6:02pm L 0.9	
8/31/2003	12:03am H 5.4	6:11am L 0.7	12:34pm H 5.9	7:01pm L 0.9
9/1/2003	1:01am H 4.6	6:46am L 1.4	1:18pm H 5.9	8:15pm L 0.9
9/2/2003	2:21am H 3.8	7:28am L 2.1	2:14pm H 5.8	9:49pm L 0.8
9/3/2003	4:25am H 3.4	8:31am L 2.7	3:29pm H 5.8	11:27pm L 0.4
9/4/2003	6:33am H 3.6	10:18am L 3.1	4:55pm H 5.9	
9/5/2003	12:42am L -0.1	7:39am H 4.1	12:00pm L 3.0	6:12pm H 6.2
9/6/2003	1:37am L -0.5	8:21am H 4.5	1:08pm L 2.6	7:12pm H 6.5
9/7/2003	2:22am L -0.8	8:55am H 4.8	2:00pm L 2.1	8:03pm H 6.7
9/8/2003	3:00am L -0.9	9:25am H 5.1	2:43pm L 1.7	8:46pm H 6.8
9/9/2003	3:33am L -0.8	9:53am H 5.3	3:22pm L 1.4	9:24pm H 6.6
9/10/2003	4:02am L -0.6	10:19am H 5.5	3:58pm L 1.1	10:00pm H 6.3
9/11/2003	4:29am L -0.2	10:43am H 5.5	4:33pm L 1.0	10:34pm H 5.9
9/12/2003	4:53am L 0.3	11:07am H 5.6	5:08pm L 1.0	11:08pm H 5.4
9/13/2003	5:16am L 0.8	11:30am H 5.5	5:44pm L 1.1	11:43pm H 4.8
9/14/2003	5:36am L 1.4	11:54am H 5.4	6:24pm L 1.2	
9/15/2003	12:22am H 4.2	5:54am L 1.9	12:19pm H 5.3	7:13pm L 1.4
9/16/2003	1:12am H 3.6	6:08am L 2.4	12:50pm H 5.1	8:22pm L 1.6
9/17/2003	2:45am H 3.1	6:09am L 2.8	1:34pm H 4.9	10:09pm L 1.6
9/18/2003	2:55pm H 4.7	11:50pm L 1.2		
9/19/2003	4:44pm H 4.8			
9/20/2003	12:47am L 0.8	8:03am H 3.9	12:07pm L 3.3	6:00pm H 5.2
9/21/2003	1:26am L 0.3	8:15am H 4.3	12:59pm L 2.8	6:53pm H 5.7
9/22/2003	1:59am L -0.1	8:32am H 4.6	1:39pm L 2.3	7:37pm H 6.1
9/23/2003	2:29am L -0.4	8:52am H 5.0	2:17pm L 1.7	8:18pm H 6.4
9/24/2003	2:58am L -0.5	9:15am H 5.4	2:54pm L 1.1	8:58pm H 6.5
9/25/2003	3:27am L -0.4	9:41am H 5.8	3:34pm L 0.5	9:40pm H 6.4
9/26/2003	3:57am L -0.2	10:09am H 6.2	4:16pm L 0.1	10:24pm H 6.1
9/27/2003	4:28am L 0.2	10:40am H 6.5	5:02pm L -0.2	11:11pm H 5.5
9/28/2003	4:59am L 0.8	11:14am H 6.6	5:53pm L -0.2	

9/29/2003	12:04am H 4.8	5:32am L 1.4	11:52am H 6.5	6:52pm L -0.1
9/30/2003	1:10am H 4.1	6:09am L 2.1	12:38pm H 6.3	8:05pm L 0.1
10/1/2003	2:46am H 3.6	6:54am L 2.8	1:38pm H 5.9	9:37pm L 0.2
10/2/2003	5:06am H 3.6	8:22am L 3.3	3:03pm H 5.6	11:10pm L 0.1
10/3/2003	6:37am H 4.0	10:43am L 3.3	4:43pm H 5.5	
10/4/2003	12:20am L -0.2	7:22am H 4.5	12:15pm L 2.9	6:04pm H 5.7
10/5/2003	1:12am L -0.4	7:56am H 4.9	1:14pm L 2.2	7:04pm H 5.9
10/6/2003	1:54am L -0.5	8:25am H 5.3	1:59pm L 1.6	7:53pm H 6.0
10/7/2003	2:28am L -0.4	8:51am H 5.6	2:38pm L 1.2	8:34pm H 5.9
10/8/2003	2:57am L -0.1	9:15am H 5.8	3:13pm L 0.8	9:11pm H 5.8
10/9/2003	3:23am L 0.2	9:37am H 5.9	3:46pm L 0.5	9:46pm H 5.5
10/10/2003	3:46am L 0.6	9:58am H 6.0	4:17pm L 0.4	10:20pm H 5.1
10/11/2003	4:07am L 1.0	10:18am H 6.0	4:49pm L 0.3	10:54pm H 4.7
10/12/2003	4:26am L 1.4	10:39am H 6.0	5:22pm L 0.4	11:30pm H 4.3
10/13/2003	4:44am L 1.9	11:00am H 5.9	5:59pm L 0.5	
10/14/2003	12:11am H 3.8	4:59am L 2.3	11:24am H 5.7	6:43pm L 0.8
10/15/2003	1:07am H 3.3	5:08am L 2.7	11:52am H 5.4	7:43pm L 1.0
10/16/2003	12:29pm H 5.1	9:10pm L 1.1		
10/17/2003	1:37pm H 4.7	10:45pm L 1.0		
10/18/2003	3:37pm H 4.6	11:50pm L 0.7		
10/19/2003	7:17am H 4.1	11:45am L 3.3	5:13pm H 4.8	
10/20/2003	12:34am L 0.3	7:27am H 4.5	12:39pm L 2.6	6:18pm H 5.2
10/21/2003	1:09am L 0.1	7:45am H 5.0	1:21pm L 1.9	7:10pm H 5.5
10/22/2003	1:42am L -0.1	8:06am H 5.5	2:01pm L 1.0	7:57pm H 5.7
10/23/2003	2:14am L 0.0	8:32am H 6.1	2:41pm L 0.2	8:44pm H 5.8
10/24/2003	2:46am L 0.1	9:00am H 6.6	3:23pm L -0.4	9:31pm H 5.7
10/25/2003	3:18am L 0.5	9:31am H 7.0	4:08pm L -0.9	10:19pm H 5.3
Standard Time Begins 10/26/2003 02:00				
10/26/2003	2:51am L 0.9	9:05am H 7.2	3:55pm L -1.2	10:12pm H 4.9
10/27/2003	3:26am L 1.4	9:42am H 7.2	4:47pm L -1.1	11:11pm H 4.4

10/28/2003	4:03am L 2.0	10:24am H 7.0	5:46pm L -0.9	
10/29/2003	12:24am H 3.9	4:45am L 2.6	11:13am H 6.5	6:55pm L -0.5
10/30/2003	2:03am H 3.7	5:44am L 3.1	12:15pm H 5.9	8:16pm L -0.2
10/31/2003	3:53am H 3.9	7:35am L 3.4	1:41pm H 5.4	9:37pm L -0.1
11/1/2003	5:03am H 4.3	9:46am L 3.2	3:20pm H 5.1	10:43pm L -0.1
11/2/2003	5:46am H 4.8	11:11am L 2.6	4:43pm H 5.0	11:34pm L 0.0
11/3/2003	6:19am H 5.2	12:07pm L 1.9	5:47pm H 5.1	
11/4/2003	12:14am L 0.1	6:47am H 5.6	12:51pm L 1.2	6:38pm H 5.0
11/5/2003	12:48am L 0.3	7:13am H 5.9	1:29pm L 0.7	7:22pm H 5.0
11/6/2003	1:16am L 0.6	7:36am H 6.1	2:02pm L 0.3	8:01pm H 4.8
11/7/2003	1:41am L 0.9	7:57am H 6.3	2:34pm L 0.0	8:38pm H 4.6
11/8/2003	2:04am L 1.3	8:19am H 6.3	3:05pm L -0.2	9:13pm H 4.4
11/9/2003	2:25am L 1.6	8:40am H 6.3	3:36pm L -0.2	9:50pm H 4.1
11/10/2003	2:46am L 2.0	9:02am H 6.3	4:09pm L -0.2	10:29pm H 3.8
11/11/2003	3:06am L 2.3	9:26am H 6.1	4:46pm L 0.0	11:14pm H 3.5
11/12/2003	3:24am L 2.6	9:53am H 5.9	5:28pm L 0.2	
11/13/2003	12:14am H 3.3	3:41am L 2.8	10:24am H 5.7	6:20pm L 0.4
11/14/2003	1:50am H 3.2	3:53am L 3.1	11:03am H 5.3	7:23pm L 0.6
11/15/2003	12:01pm H 4.9	8:34pm L 0.6		
11/16/2003	4:54am H 3.8	7:53am L 3.6	1:33pm H 4.6	9:38pm L 0.5
11/17/2003	5:08am H 4.2	10:03am L 3.2	3:17pm H 4.5	10:29pm L 0.5
11/18/2003	5:29am H 4.7	11:11am L 2.4	4:39pm H 4.5	11:12pm L 0.4
11/19/2003	5:53am H 5.3	12:01pm L 1.4	5:45pm H 4.7	11:52pm L 0.5
11/20/2003	6:21am H 6.0	12:46pm L 0.4	6:42pm H 4.9	
11/21/2003	12:29am L 0.6	6:52am H 6.6	1:30pm L -0.5	7:36pm H 4.9
11/22/2003	1:07am L 0.9	7:25am H 7.1	2:15pm L -1.2	8:29pm H 4.9
11/23/2003	1:45am L 1.1	8:02am H 7.5	3:02pm L -1.7	9:22pm H 4.7
11/24/2003	2:23am L 1.5	8:41am H 7.7	3:50pm L -1.8	10:17pm H 4.4
11/25/2003	3:04am L 1.9	9:23am H 7.6	4:42pm L -1.7	11:17pm H 4.2
11/26/2003	3:48am L 2.2	10:09am H 7.2	5:37pm L -1.4	
11/27/2003	12:24am H 4.0	4:39am L 2.6	10:59am H 6.6	6:37pm L -1.0

11/28/2003	1:41am H 3.9	5:47am L 3.0	11:58am H 5.9	7:42pm L -0.5
11/29/2003	3:01am H 4.1	7:25am L 3.2	1:12pm H 5.2	8:49pm L -0.1
11/30/2003	4:07am H 4.5	9:19am L 2.9	2:40pm H 4.6	9:50pm L 0.2
12/1/2003	4:55am H 4.9	10:48am L 2.3	4:09pm H 4.3	10:42pm L 0.5
12/2/2003	5:33am H 5.3	11:51am L 1.7	5:23pm H 4.1	11:25pm L 0.8
12/3/2003	6:05am H 5.6	12:38pm L 1.0	6:23pm H 4.1	
12/4/2003	12:02am L 1.1	6:33am H 5.9	1:17pm L 0.5	7:14pm H 4.1
12/5/2003	12:34am L 1.4	6:59am H 6.1	1:52pm L 0.0	7:58pm H 4.0
12/6/2003	1:03am L 1.7	7:24am H 6.3	2:25pm L -0.3	8:38pm H 4.0
12/7/2003	1:30am L 1.9	7:49am H 6.4	2:57pm L -0.5	9:16pm H 3.9
12/8/2003	1:57am L 2.1	8:15am H 6.4	3:29pm L -0.6	9:54pm H 3.8
12/9/2003	2:23am L 2.3	8:42am H 6.4	4:02pm L -0.6	10:33pm H 3.7
12/10/2003	2:49am L 2.4	9:11am H 6.3	4:37pm L -0.5	11:15pm H 3.6
12/11/2003	3:17am L 2.6	9:42am H 6.2	5:15pm L -0.4	
12/12/2003	12:02am H 3.5	3:49am L 2.8	10:16am H 5.9	5:57pm L -0.2
12/13/2003	12:57am H 3.5	4:31am L 3.0	10:55am H 5.6	6:42pm L 0.0
12/14/2003	1:58am H 3.6	5:38am L 3.2	11:45am H 5.1	7:32pm L 0.2
12/15/2003	2:54am H 3.9	7:20am L 3.2	12:53pm H 4.6	8:24pm L 0.5
12/16/2003	3:41am H 4.4	9:13am L 2.8	2:26pm H 4.1	9:18pm L 0.7
12/17/2003	4:21am H 4.9	10:39am L 2.0	4:04pm H 3.9	10:11pm L 1.0
12/18/2003	5:00am H 5.5	11:42am L 1.0	5:29pm H 3.9	11:02pm L 1.2
12/19/2003	5:39am H 6.2	12:35pm L 0.0	6:40pm H 4.1	11:50pm L 1.4
12/20/2003	6:19am H 6.8	1:24pm L -0.9	7:40pm H 4.2	
12/21/2003	12:37am L 1.6	7:01am H 7.3	2:12pm L -1.6	8:35pm H 4.3
12/22/2003	1:24am L 1.7	7:44am H 7.7	2:59pm L -2.0	9:27pm H 4.4
12/23/2003	2:10am L 1.8	8:29am H 7.8	3:46pm L -2.1	10:17pm H 4.3
12/24/2003	2:56am L 1.9	9:14am H 7.6	4:33pm L -2.0	11:08pm H 4.3
12/25/2003	3:45am L 2.1	10:01am H 7.2	5:21pm L -1.6	
12/26/2003	12:00am H 4.2	4:38am L 2.3	10:49am H 6.6	6:09pm L -1.1
12/27/2003	12:56am H 4.2	5:39am L 2.5	11:39am H 5.8	6:58pm L -0.5
12/28/2003	1:54am H 4.3	6:55am L 2.6	12:37pm H 5.0	7:48pm L 0.1

12/29/2003	2:53am H 4.5	8:28am L 2.6	1:48pm H 4.2	8:40pm L 0.7
12/30/2003	3:47am H 4.8	10:07am L 2.2	3:19pm H 3.6	9:32pm L 1.2
12/31/2003	4:35am H 5.1	11:25am L 1.6	4:56pm H 3.4	10:24pm L 1.6

Heat Index

The NWS has devised the Heat Index, sometimes called the “apparent temperature.” It is the temperature the body feels when the heat and humidity are combined. High relative humidity inhibits the evaporation of perspiration and hence the body’s ability to cool itself.

For more information about the heat index, click on: **weather.noaa.gov/weather/hwave.html** and **www.srh.noaa.gov/bmx/tables/heat_index.html**

Note: Exposure to full sunshine can increase HI values by up to 15˚ F

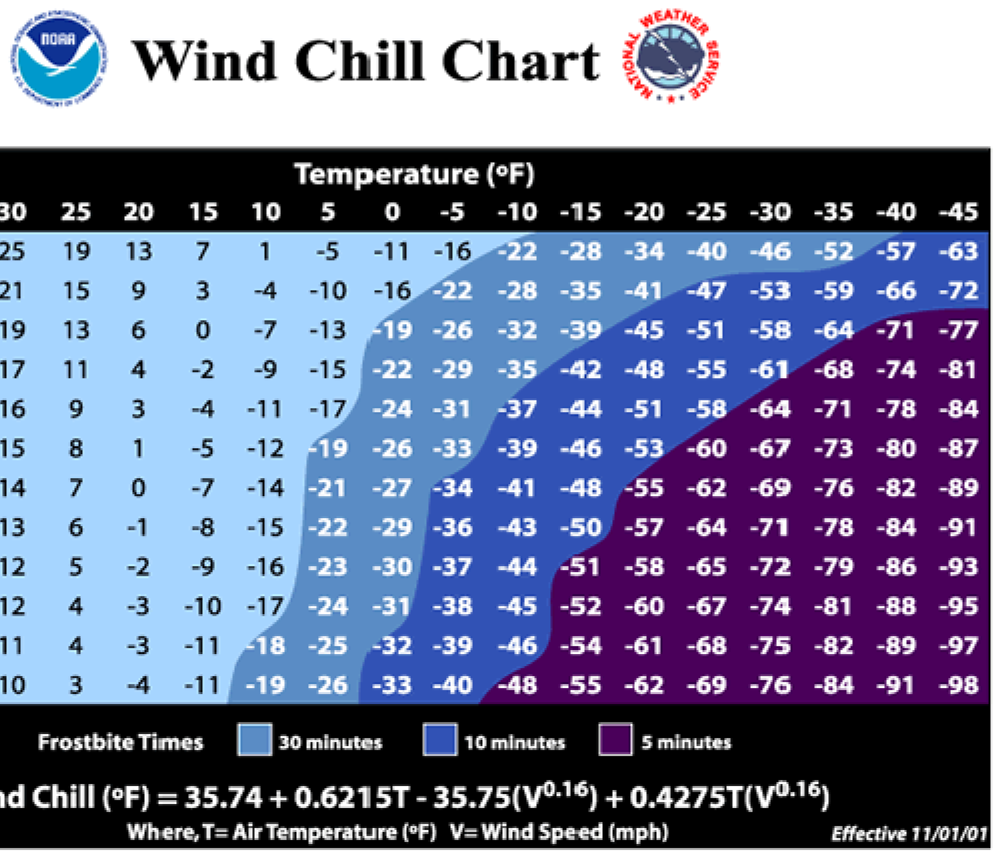
	Relative Humidity												
	40	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**
110	136												
108	130	137											
106	124	130	137										
104	119	124	131	137									
102	114	119	124	130	137								
100	109	114	118	124	129	136							
98	105	109	113	117	123	128	134						
96	101	104	108	112	116	121	126	132					
94	97	100	103	106	110	114	119	124	129	136			
92	94	96	99	101	105	108	112	116	121	126	131		
90	91	93	95	97	100	103	105	110	113	117	122	127	132
88	88	89	91	93	95	98	100	103	106	110	113	117	121
86	85	87	88	89	91	93	95	97	100	102	105	108	112
84	83	84	85	86	88	89	90	92	94	96	98	100	103
82	81	82	83	84	84	85	86	88	89	90	91	93	95
80	80	80	81	81	82	82	83	84	84	85	86	86	87

Heat Index	**Possible heat disorders for people in higher risk groups**
130˚ or higher	Heat stroke or sunstroke likely.

105 - 129˚	Sunstroke, muscle cramps, and/or heat exhaustion likely. Heatstroke possible with prolonged exposure and/or physical activity.
90˚ - 104˚F	Sunstroke, heat cramps and heat exhaustion possible with prolonged exposure and/or physical activity.
80˚ - 89˚F	Fatigue possible with prolonged exposure and/or physical activity.

Wind Chill Index

For more information about wind chill, click on: **www.nws.noaa.gov/om/windchill/index.shtml** and **www.nws.noaa.gov/om/windchill/windchillglossary.shtml**



Wind (mph)	Temperature (°F)																	
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Ultraviolet Index

The Environmental Protection Agency (EPA) and the National Weather Service developed the Ultraviolet Index (UVI). It provides important information to help you plan your outdoor activities and prevent overexposure to the sun's rays.
For more information about the UVI, click on:
www.cpc.ncep.noaa.gov/products/stratosphere/uv_index and
www.epa.gov/sunwise/uvindex.html

The UV index is categorized by the EPA as follows:

UVI	**Exposure Level**
0 1 2	Minimal
3 4	Low
5 6	Moderate
7 8 9	High
10 and greater	Very High

Tropical Cyclones

Common Definitions

Tropical Depression	**Tropical Storm**	**Hurricane**
Wind less than 33 kt (39 mph)	Wind 34 to 63 kt (39-73 mph)	Wind greater than 63 kt (73 mph)

The Saffir-Simpson Hurricane Scale

The Saffir-Simpson Hurricane Scale is a 1-5 rating based on the hurricane's present intensity. This is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, as storm surge values are highly dependent on the slope of the continental shelf in the landfall region. Note that all winds are using the U.S. 1-minute average. For more information about hurricanes, click on: www.nhc.noaa.gov

<u>Category One Hurricane</u>:
Winds 74-95 mph (64-82 kt or 119-153 km/hr). Storm surge generally 4-5 ft above normal. No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Some damage to poorly constructed signs. Also, some coastal road flooding and minor pier damage. Hurricanes Allison of 1995 and Danny of 1997 were Category One hurricanes at peak intensity.

<u>Category Two Hurricane</u>:
Winds 96-110 mph (83-95 kt or 154-177 km/hr). Storm surge generally 6-8 feet above normal. Some roofing material, door, and window damage of buildings. Considerable damage to shrubbery and trees with some trees blown down. Considerable damage to mobile homes, poorly constructed signs, and piers. Coastal and low-lying escape routes flood 2-4 hours before arrival of the hurricane center. Small craft in unprotected anchorages break moorings. Hurricane Bonnie of 1998 was a Category Two hurricane when it hit the North Carolina coast, while Hurricane Georges of 1998 was a Category Two Hurricane when it hit the Florida Keys and the Mississippi Gulf Coast.

<u>Category Three Hurricane</u>:
Winds 111-130 mph (96-113 kt or 178-209 km/hr). Storm surge generally 9-12 ft above normal. Some structural damage to small residences and utility buildings with a minor amount of curtainwall failures. Damage to shrubbery and trees with foliage blown off trees and large tress blown down. Mobile homes and poorly constructed signs are destroyed. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the hurricane center. Flooding near the coast destroys smaller structures with larger

structures damaged by battering of floating debris. Terrain continuously lower than 5 ft above mean sea level may be flooded inland 8 miles (13 km) or more. Evacuation of low-lying residences with several blocks of the shoreline may be required. Hurricanes Roxanne of 1995 and Fran of 1996 were Category Three hurricanes at landfall on the Yucatan Peninsula of Mexico and in North Carolina, respectively.

Category Four Hurricane:
Winds 131-155 mph (114-135 kt or 210-249 km/hr). Storm surge generally 13-18 ft above normal. More extensive curtainwall failures with some complete roof structure failures on small residences. Shrubs, trees, and all signs are blown down. Complete destruction of mobile homes. Extensive damage to doors and windows. Low-lying escape routes may be cut by rising water 3-5 hours before arrival of the hurricane center. Major damage to lower floors of structures near the shore. Terrain lower than 10 ft above sea level may be flooded requiring massive evacuation of residential areas as far inland as 6 miles (10 km). Hurricane Luis of 1995 was a Category Four hurricane while moving over the Leeward Islands. Hurricanes Felix and Opal of 1995 also reached Category Four status at peak intensity.

Category Five Hurricane:
Winds greater than 155 mph (135 kt or 249 km/hr). Storm surge generally greater than 18 ft above normal. Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. All shrubs, trees, and signs blown down. Complete destructon of mobile homes. Severe and extensive window and door damage. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the hurricane center. Major damage to lower floors of all structures located less than 15 ft above sea level and within 500 yards of the shoreline. Massive evacuation of residential areas on low ground within 5-10 miles (8-16 km) of the shoreline may be required. Hurricane Mitch of 1998 was a Category Five hurricane at peak intensity over the western Caribbean. Hurricane Gilbert of 1988 was a Category Five hurricane at peak intensity and is the strongest Atlantic tropical cyclone of record.

Tropical Cyclone Names

Names have been given to tropical cyclones attaining tropical storm status by the National Hurricane Center since 1953. Currently, the name lists are maintained and updated by an international committee of the World Meteorological Organization. The lists featured only women's names until 1979. Since then, men's and women's names have been alternated. When a hurricane is particularly deadly or costly, the name is retired and a new name is chosen to replace it. These lists are recycled every six years (the 2002 list will be used again in 2008).
For more information about the naming of tropical cyclones and hurricanes, click on:
www.nhc.noaa.gov/aboutnames.shtml

Eastern North Pacific Names

2002	2003	2004	2005	2006	2007
Alma	Andres	Agatha	Adrian	Aletta	Alvin
Boris	Blanca	Blas	Beatriz	Bud	Barbara
Cristina	Carlos	Celia	Calvin	Carlotta	Cosme
Douglas	Dolores	Darby	Dora	Daniel	Dalila
Elida	Enrique	Estelle	Eugene	Emilia	Erick
Fausto	Felicia	Frank	Fernanda	Fabio	Flossie
Genevieve	Guillermo	Georgette	Greg	Gilma	Gil
Hernan	Hilda	Howard	Hilary	Hector	Henriette
Iselle	Ignacio	Isis	Irwin	Ileana	Ivo
Julio	Jimena	Javier	Jova	John	Juliette
Kenna	Kevin	Kay	Kenneth	Kristy	Kiko
Lowell	Linda	Lester	Lidia	Lane	Lorena
Marie	Marty	Madeline	Max	Miriam	Manuel
Norbert	Nora	Newton	Norma	Norman	Narda
Odile	Olaf	Orlene	Otis	Olivia	Octave
Polo	Patricia	Paine	Pilar	Paul	Priscilla
Rachel	Rick	Roslyn	Ramon	Rosa	Raymond
Simon	Sandra	Seymour	Selma	Sergio	Sonia
Trudy	Terry	Tina	Todd	Tara	Tico
Vance	Vivian	Virgil	Veronica	Vicente	Velma
Winnie	Waldo	Winifred	Wiley	Willa	Wallis
Xavier	Xina	Xavier	Xina	Xavier	Xina
Yolanda	York	Yolanda	York	Yolanda	York
Zeke	Zelda	Zeke	Zelda	Zeke	Zelda

Atlantic Names

2002	2003	2004	2005	2006	2007
Arthur	Ana	Alex	Arlene	Alberto	Andrea
Bertha	Bill	Bonnie	Bret	Beryl	Barry
Cristobal	Claudette	Charley	Cindy	Chris	Chantal
Dolly	Danny	Danielle	Dennis	Debby	Dean
Edouard	Erika	Earl	Emily	Ernesto	Erin
Fay	Fabian	Frances	Franklin	Florence	Felix
Gustav	Grace	Gaston	Gert	Gordon	Gabrielle
Hanna	Henri	Hermine	Harvey	Helene	Humberto
Isidore	Isabel	Ivan	Irene	Isaac	Ingrid
Josephine	Juan	Jeanne	Jose	Joyce	Jerry
Kyle	Kate	Karl	Katrina	Kirk	Karen
Lili	Larry	Lisa	Lee	Leslie	Lorenzo
Marco	Mindy	Matthew	Maria	Michael	Melissa
Nana	Nicholas	Nicole	Nate	Nadine	Noel
Omar	Odette	Otto	Ophelia	Oscar	Olga
Paloma	Peter	Paula	Philippe	Patty	Pablo
Rene	Rose	Richard	Rita	Rafael	Rebekah
Sally	Sam	Shary	Stan	Sandy	Sebastien
Teddy	Teresa	Tomas	Tammy	Tony	Tanya
Vicky	Victor	Virginie	Vince	Valerie	Van
Wilfred	Wanda	Walter	Wilma	William	Wendy

Tornadoes - The Fujita (F) Scale

The Fujita (F) Scale was developed in 1971 by T. Theodore Fujita of the University of Chicago. It is a scale that measures the severity of tornadoes based on extent of damage.
For more information about tornadoes, click on: **www.spc.noaa.gov/faq/tornado**

Scale	**Wind Estimate* (mph)**	**Typical Damage**
F0	< 73	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.
F5	261-318	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yds); trees debarked; incredible phenomena will occur.

* IMPORTANT NOTE ABOUT F-SCALE WINDS: Do not use F-scale winds literally. These precise wind speed numbers are actually guesses and have never been scientifically verified. Different wind speeds may cause similar looking damage from place to place, even from building to building. Without a thorough engineering analysis of tornado damage in any event, the actual wind speeds needed to cause that damage are unknown.

Earthquake Magnitude Classes (based on the Richter Scale)

Although the National Weather Service has no earthquake responsibility, information can be relayed through the agency's communications networks. For more information on earthquakes, with a focus on Southern California, click on: **pasadena.wr.usgs.gov**

Classes	**Magnitude**
Great	Greater than or equal to 8
Major	7 to 7.9
Strong	6 to 6.9
Moderate	5 to 5.9
Light	4 to 4.9
Minor	3 to 3.9
Micro	Less than 3

Appendix G - Web Sites for Weather Information

Forecasts, Current Conditions, Maps, Satellite, Radar, Etc.

National Weather Service (NWS) San Diego	www.wrh.noaa.gov/sandiego
Servicio Nacional de Meteorología - San Diego	www.wrh.noaa.gov/sandiego/espanol.html
Western U.S. Quick Forecasts	www.wrh.noaa.gov/wrhq/javaLinks/index.html
NWS Forecast Office Web Pages Nationwide	www.wrh.noaa.gov/wrhq/nwspage.html
NWS Forecasts, Warnings, Radars and Satellites	www.nws.noaa.gov/data.html
NWS Interactive Weather Information Network - IWIN	weather.gov
NWS Internet Weather Source	weather.noaa.gov
IPS Meteostar Weather Products	wxweb.meteostar.com
University of Michigan Weather	yang.sprl.umich.edu/wxnet
Weather Underground	www.wunderground.com
The Weather Channel	www.weather.com
CNN Weather	www.cnn.com/WEATHER

Weather Maps - Models

Selection of Weather Maps	www.hpc.ncep.noaa.gov/html/fcsttxt.html
Environmental Modeling Center	www.emc.ncep.noaa.gov
List of Numerical Weather Prediction Sites	www.nhc.noaa.gov/aboutlinkmodel.html
Guide to Reading Weather Maps	ww2010.atmos.uiuc.edu/(Gh)/guides/maps/home.rxml

Weather Learning - Education and Research

NWS Weather Tutorial	www.srh.weather.gov/jetstream
Links to Weather Education	www.nws.mbay.net/wx.html
NWS Office of Climate, Water and Weather Services	www.nws.noaa.gov/om
USA Today Weather Basics Page	www.usatoday.com/weather/basics/wworks0.htm
Resources for Educators	www.nws.noaa.gov/om/edures.htm

Univ. of IL Meteorology Guide	ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/home.rxml
How the Weather Works Homepage	www.weatherworks.com
National Center for Atmospheric Research	www.ncar.ucar.edu
University Corporation for Atmospheric Research	www.ucar.edu
NOAA Research	www.oar.noaa.gov
NOAA Hurricane Research Division	www.aoml.noaa.gov/hrd
Center for Ocean-Land-Atmospheric Studies (COLA)	grads.iges.org/pix/head.html
Goddard Institute for Space Studies - Global Climate	www.giss.nasa.gov
NCDC Climate Research - Global Warming	www.ncdc.noaa.gov/ol/climate/climateresearch.html
Global Fluid Dynamics Laboratory Weather & Climate	www.gfdl.noaa.gov/~gth/web_page/climate_and_weather.html
Listing of Meteorology Schools Nationwide	www.nssl.noaa.gov/edu/schools.html
UCLA Department of Atmospheric Sciences	www.atmos.ucla.edu
Meteorology Degrees and Career Options	www.nssl.noaa.gov/faq/metcareer.shtml

Weather for Young Students and Their Teachers

NOAA Play Time For Kids	www.nws.noaa.gov/om/reachout/kids.htm
NOAA Weather Education	www.education.noaa.gov
National Severe Storms Laboratory Weather Room	www.nssl.noaa.gov/edu
Weather Education Links	www.crh.noaa.gov/mkx/edu.htm
Discovery School Weather	school.discovery.com/homeworkhelp/worldbook/atozscience/w/596160.html
Dan’s Wild Wild Weather Page for Kids	www.wildwildweather.com
Nationwide School Weather Network	www.aws.com

WeatherEye - Teacher and Student Activities	www.weathereye.kgan.com
The Globe Program	globe.fsl.noaa.gov
One Sky Many Voices Program	groundhog.sprl.umich.edu/index.html
FEMA for Kids	www.fema.gov/kids
Severe Weather Plan for Schools	www.nws.noaa.gov/er/lwx/swep/index.htm

Stormy Weather: Winter Storms, Thunderstorms, Lightning, Hail, Tornadoes and Disaster Preparedness

NWS Winter Weather Awareness	www.nws.noaa.gov/om/winter
Storm Prediction Center	www.spc.noaa.gov
National Severe Storms Laboratory	www.nssl.noaa.gov
The Tornado Project	www.tornadoproject.com
Stormtrack Storm Chaser Homepage	www.stormtrack.org
National Lightning Safety Institute	www.lightningsafety.com
Severe Weather Awareness	www.nws.noaa.gov/om/severeweather
StormReady	www.nws.noaa.gov/stormready
Spotter and Skywarn Page - San Diego	www.wrh.noaa.gov/sandiego/spotter/skywarn.htm
Federal Emergency Management Agency	www.fema.gov
The Disaster Center	www.disastercenter.com

Hurricanes and Tropical Weather

Tropical Storm Tracker	www.solar.ifa.hawaii.edu/Tropical/tropical.html
National Hurricane Center - Eastern Pacific Page	www.nhc.noaa.gov/graphicsepac.html
National Hurricane Center	www.nhc.noaa.gov
Central Pacific Hurricane Center	www.nws.noaa.gov/pr/hnl/cphc/pages/cphc.shtml
Atlantic Tropical Weather Center	www.atwc.org
NWS Hurricane Awareness	www.nws.noaa.gov/om/hurricane
Good Hurricane Resources	ggweather.com/hurricane.htm
Hay’s Tropical Weather Pages	jrscience.wcp.muohio.edu/coriolis/hurricanes.html

Rainfall, Floods and Drought

Local Rainfall Maps and Charts	www.wrh.noaa.gov/sandiego/local.html#Precip
California - Nevada River Forecast Center	www.wrh.noaa.gov/cnrfc
Hydrometeorological Prediction Center	www.hpc.ncep.noaa.gov
California Data Exchange Center	cdec.water.ca.gov
California Department of Water Resources	wwwdwr.water.ca.gov
Climate Diagnostics Center Droughts and Floods	www.cdc.noaa.gov/ClimateInfo/drought.html
NOAA's Drought Information Center	www.drought.noaa.gov
National Drought Mitigation Center	enso.unl.edu/ndmc

Climate Data and Long Term Prediction

Climate Diagnostics Center (El Niño, La Nina)	www.cdc.noaa.gov
NOAA's El Niño Theme Page	www.pmel.noaa.gov/toga-tao/el-nino/nino-home.html
Climate Prediction Center	www.cpc.noaa.gov
Seasonal Outlooks from CPC	www.cpc.ncep.noaa.gov/products/forecasts
Western Regional Climate Center	www.wrcc.dri.edu
National Climatic Data Center	www.ncdc.noaa.gov
Weatherbase Climate Data	www.weatherbase.com

Aviation Weather

Aviation Digital Data Service	adds.awc-kc.noaa.gov
Aviation Weather Center	www.awc-kc.noaa.gov
NWS Aviation Program	www.nws.noaa.gov/om/aviation.htm
NWS San Diego Aviation Page	www.wrh.noaa.gov/sandiego/aviation.html
USA Today Aviation Weather	www.usatoday.com/weather/wpilots0.htm
Air Traffic Control System Command Center	www.atcscc.faa.gov

Marine Weather and Surf

NWS Marine Weather Homepage	www.nws.noaa.gov/om/marine/home.htm
Marine Prediction Center	www.mpc.ncep.noaa.gov

Guide to Marine Weather Services	www.nws.noaa.gov/om/marine2.htm
National Data Buoy Center	www.ndbc.noaa.gov
Surfline Surf Reports and Cams	www.swell.com/sw/surflinehome
Surflink Surf Reports and Cams	www.surflink.com
Sea Surface Temperatures in California and Baja (daily)	www.nws.mbay.net/sst1.gif
NWS San Diego Marine Page	www.wrh.noaa.gov/sandiego/marine.html
La Jolla Surfing Weather	facs.scripps.edu/surf/weather.shtml
Scripps Institution of Oceanography Weather & Climate	www.sio.ucsd.edu/research/atmosphere.html
Coastwatch Program - West Coast	cwatchwc.ucsd.edu
Naval Research Laboratory Marine Meteorology	kauai.nrlmry.navy.mil/tc-bin/tc_home
Marine Weather and More	www.marineweather.com
West Coast Tsunami Warning Center	wcatwc.gov/main.htm

Weather Organizations, Publications

National Weather Service Headquarters	www.nws.noaa.gov
National Oceanic and Atmospheric Administration	www.noaa.gov
World Meteorological Organization	www.wmo.ch/indexflash.html
Foreign Weather Services	www.nhc.noaa.gov/aboutlinkabroad_short.html
American Meteorological Society	www.ametsoc.org/AMS
AMS San Diego Local Chapter	amssandiego.org
National Weather Association	www.nwas.org
California Weather Association	www.west.net/~ke6jqp/cwa.htm
Weatherwise Magazine	www.weatherwise.org
Mariners Weather Log Magazine	www.nws.noaa.gov/om/mwl/mwl.htm
Index of Weather Books from USA Today	www.usatoday.com/weather/science/books/books0.htm

Miscellaneous

Space Environment Center	www.sec.noaa.gov
Space Weather	www.spaceweather.com
Old Farmer's Almanac Long Range Forecasts	www.almanac.com/weather/weather.html
Huge List of Commercial Weather Companies	www.nws.noaa.gov/im/more.htm
Enormous List of Weather Websites	cirrus.sprl.umich.edu/wxnet/servers.html
Local NOAA Weather Radio Information	www.wrh.noaa.gov/sandiego/wxradio.html
National NOAA Weather Radio Information	www.nws.noaa.gov/nwr
A Virtual Library of Resources	www.nssl.noaa.gov/resources/resourceguide.pdf